Using Computer Mediated Role-play to Investigate Indiscriminate Friendliness in Children

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Abstract

A breadth of research highlights the benefits of utilising computer technologies in research with children. In middle childhood, social understanding and atypical behaviour patterns are difficult to assess through traditional interviews or questionnaires because many children do not have the verbal sophistication required to complete these accurately. Indiscriminate friendliness (IF) or over-friendliness with strangers can leave children socially vulnerable. Currently, it is assessed qualitatively by clinicians or quantitatively through parent or teacher reports. To increase validity and reliability, we need more quantifiable measures to capture children's "real world" behaviours. The present research aims to create a more ecologically valid measure of IF using computer mediated role-play, and to disentangle the strongest psychological predictors of IF in middle childhood. I carried out five empirical studies with primary-aged school children (including data from looked after children). They were asked to comprehend novel story vignettes and role-play various characters in a variety of computer scenarios to investigate theory of mind and IF/Disinhibited Social Engagement (DSE). I created bespoke versions of social stories measuring IF comprised of "paper pencil" story vignettes and two matching computer mediated role-play measures. Children also completed story vignettes measuring Theory of Mind (ToM) and a battery of cognitive tests, comprised of IQ, cool and hot executive function (EF). Parents and teachers completed emotional, behavioural and social questionnaires about the children. I found developmental (age) differences in IF. Specifically, 6-year-olds displayed significantly more IF behaviours than either 8 or 10-year olds. I discuss the potential advantages of computer mediated role-play in comparison to "paper pencil" tasks in middle childhood. I also found that ToM and general social cognition are the key predictors of IF and social vulnerability. There was some indication of a relationship with EF tasks, but the most robust predictors were the social cognitive factors. A pilot study of a bespoke computer game revealed the advantages and disadvantages of the software used. This research also highlights the importance of the methodology of computer mediated role-play for measuring IF in children. This thesis has implications for the way researchers and clinicians measure children's social behaviours. I argue that this research is essential for informing practitioners and policy makers on approaches for early intervention in groups of children who are at risk of becoming socially vulnerable, for example, those in foster care or those with autism spectrum disorders.

Dedication

For Mum, Dad, Hayleigh and Anelise with love

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List of Abbreviations

ADHD	Attention Deficit Hyperactivity Disorder
ANOVA	Analysis of Variance
APA	American Psychiatric Association
ASD	Autism Spectrum Disorders
CMCAST	Computerised Manchester Child Attachment Story Task
DAD	Disinhibited Attachment Disorder
DCCS	Dimension Change Card Sort
DSE	Disinhibited Social Engagement
DSED	Disinhibited Social Engagement Disorder
DSM	Diagnostic and Statistical Manual of Mental Disorders
EF	Executive Functioning
GIRFEC	Getting It Right for Every Child
HDT	Hungry Donkey Task
IF	Indiscriminate Friendliness
IGT	Iowa Gambling Task
MCAST	Manchester Child Attachment Story Task
LAC	Looked After Children
LEA	Local Education Authority
LRC	Low Risk Children
RAD	Reactive Attachment Disorder
RPQ	Relationship Problems Questionnaire
SHANRRI	Safe, Healthy, Active, Nurtured, Responsible, Respected, Included
SD	Standard Deviation
SDQ	Strengths and Difficulties Questionnaire
SG	Scottish Government
SRS-2	Social Responsiveness Scale - Second Edition
SSP	Strange Situations Procedure
ToM	Theory of Mind
UNCRC	United Nations Convention of the Rights of the Child
VMPFC	Ventromedial Prefrontal Cortex
VLE	Virtual Learning Environment
WASI-II	Wechsler Abbreviated Scales of Intelligence-Second Edition

Chapter 1: General Introduction

1.1: Children and Technology

Children's usage of technology is now widespread in day to day life. As well as providing learning and entertainment, it has opened an exciting avenue for research to help children with social and cognitive difficulties via intervention and clinical assessment. Research in this field tends to integrate computer technology with real world-based activities, as a means to carry out research with children in a controlled and ethical environment. Extant research suggests that individuals treat computerised objects and space just as they do when interacting in "real-world" social situations and relationships (e.g. Reeves & Nass, 1996). So, this social interaction with computers facilitates a 'safer' and controllable environment in which to assess children and young people's behaviours in social relationships and environments – but without losing real-world engagement.

The most popular areas of research in this area tend to be interventions to improve social skills, cognitive skills, and learning (Beals, 2016; Vannini et al., 2011, Wass, & Porayska-Pomsta, 2013). By contrast, my research reported in this thesis uses this technology for psychological and behavioural assessment in children.

1.2: Positive and negative aspects of technology usage for children

Initial research focused on the negative impacts of playing video games including a widely circulated meta-analytic review by Anderson and Bushman, (2001) which suggests that playing video games increases aggressive behaviour in children and young people, this evidence continued onto a number of other publications by these authors (e.g. Anderson 2004; Anderson et al., 2010). Evidence for a relationship between violent video games and aggression is, however, mixed. Violent video games, which are incredibly popular among young people (Lenhart et al., 2008), have been shown to raise aggression levels (Anderson et al., 2010), but further research highlights that a small positive correlation does not necessarily mean causation (e.g. Weber, Ritterfield, Mathiak, 2006) and many researchers have failed to demonstrate any relationship between violent video game play and aggression (e.g. Ferguson & Reuda, 2010; Adachi & Willoughby, 2011).

More positively, over the last two decades Developmental and Social psychologists have primarily focused on the beneficial outcomes of playing games. Early results from Durkin and Barber (2002), suggested that teenagers who play computer games had more favourable outcomes with respect to closer family relationships, more school engagement, involvement in other leisure activities, good mental health, were less

likely to abuse substances, and had a good network of friends - meaning that playing these games is deemed to be a factor contributing to positive general outcomes for this group of adolescents. Gee (2014) argues that video games provide children with positive challenges and helps to forge the development of higher-order cognitive thinking such as planning and problem-solving.

Indeed, there is now much evidence from systematic reviews which overwhelmingly supports the argument that serious games can contribute positively to knowledge and skill acquisition (Boyle, Connolly, Hainey & Boyle 2012; Boyle et al., 2016). Furthermore, both typically and atypically developing children play video games for pleasure. They will immerse themselves in these games and increasingly, interact with peers for hours through online gaming, despite perhaps having cognitive or social issues which cause them difficulties with other everyday "real world" tasks (Durkin, 2010). Serious games and computer games, in general, can give children a sense of normalcy, and the ability to participate with peers in this platform can improve self-esteem and well-being (Durkin, Boyle, Hunter & Conti-Ramsden 2013). Also due to the wealth of evidence suggests that children and young people enjoy playing video games and are intrinsically motivated to play these games, it seems they can promote positive development in children (Adachi & Willoughby, 2012). Thus, this passion could be harnessed to enhance learning and behaviour in children. Studies employing new technologies could provide us with theoretical insights into new diagnostic categories and individual behavioural profiles (Rajendran, 2013). Undoubtedly, how children with different symptoms use and learn from technology can provide understanding of their cognitive, social and emotional characteristics (Fletcher-Watson & Durkin, 2014).

These ideas have led to the popularity of serious games; while a "traditional" commercially available video game is defined as a physical or mental contest, played according to set rules, with the goal of entertaining or rewarding the players (Zyda, 2005). A serious game on the other hand is a computer game in which the creators have concealed an educational or training purpose (Stokes, 2005). Within the context of this thesis, the term is used to refer to computer games or computer mediated scenarios that have a serious purpose rather than for entertainment e.g. as an assessment or intervention tool to research and measure children's social behaviours.

1.3: The role of serious games as social skills interventions for children and young people

Technology and skills in using technology offer much to individuals with additional support needs. Video games can provide cognitive and perceptual stimulation, alternative or supplementary modes of communication, and a means of making or strengthening connections within the peer community (Fletcher-Watson & Durkin, 2014). They can also provide rich data and dynamic environments in which to collect detailed data about cognitive, perceptual, social processes and spontaneous preferences, meaning that with careful design computer games can be employed as a naturalistic research tool providing multiple insights (Fletcher- Watson, 2014).

Recent research from a range of disciplines including psychology, psychiatry, education and computer science (e.g. Fletcher -Watson et al 2014; Hall, Woods, & Hall, 2009; Minnis et al., 2010; Porayska-Pomsta, 2012; Rajendran, Mitchell, & Rickards, 2005) have highlighted the potential benefits of utilising technologies in the measurement and intervention of social behaviour in various groups of children, particularly those with Autism Spectrum Disorder (ASD). Individuals with ASD exhibit impairment in social functions including problems in social interactions, social communication, and emotion recognition (American Psychiatric Association, 2000; Hooper, Poon, Marcus, & Fine, 2006). The DSM-V characterises autism spectrum disorders (ASD) into 3 severity levels with level 3 demonstrating the most severe impairment in social communication and needing "very substantial support." The higher functioning, level 1 individuals with ASD, tend to have difficulty processing social cues and due to this may become overwhelmed and anxious in social exchanges, particularly with unfamiliar people (Bernard-Opitz, Sriram, & Nakhoda-Sapuan, 2001; Hobson, Ouston, & Lee, 1989; Volkmar, Cohen, Bergman, Hooks, & Stevenson, 1989).

Those with ASD (particularly high functioning level 1) seem to display an affinity with technologies (Rajendran 2013; Wass, & Porayska-Pomsta, 2013). Computer mediated social guidance offers several advantages compared to traditional social skills interventions. They can provide a safe, unrestricted, and day-to-day environment to practice social scenarios, such as making friends at school or inviting friends to a birthday party (Kandalaft et al., 2013; Parsons, Mitchell, & Leonard, 2005; Wallace, Parsons, Westbury, White, & Bailey, 2010). Firstly, it can lessen the social anxieties that are found in real life social scenarios (Maskey et al., 2014). Second, computer mediated interventions provide the opportunity for repeated practice in an endless variety of

dynamic social exchanges. A key benefit is that there is considerably less focus on rote learning and responses over many training sessions because in the real world it is rare to encounter two social situations that are the same. It is suggested that having an active and easy to change virtual environment will help children with social communication difficulties interact in different everyday social situations (Bellani, Fornasari, Chittaro, & Brambilla, 2011; Parsons & Cobb, 2011; Tzanavari, Charalambous-Darden, Herakleous, & Poullis, 2015). Finally, virtual platforms can deliver a supportive setting for individuals with disorders that affect communication to make social mistakes without experiencing the fear of rejection or anxiety that is common in face to face social situations.

At present the vast majority of the research on technology-based measurement and intervention tools are largely focused on facilitating children and young people with ASD, (e.g. Fletcher-Watson, Pain, Hammond Humphry, McConachie 2016; Parsons, 2016; Wass, & Porayska-Pomsta, 2013). There are many similar research endeavours aimed at supporting children with other developmental and psychological disorders e.g. Attention Deficit Hyperactivity Disorder (ADHD) and Specific Language Impairment (SLI: Flecher-Watson & Durkin 2014). The utility of storytelling apps seems especially beneficial for understanding children's social development. Indeed, social difficulties may be in part due to issues with social cognitive functioning. Social cognition provides automatic, process-orientated accounts of multifaceted social phenomena that enable individuals to communicate with others successfully (Frith 2008). Happé and Frith, (2014) highlighted that there are a number of developmental disorders which are primarily characterised by social cognitive atypicality other than Autism Spectrum disorders e.g. Williams Syndrome, Downs Syndrome, ADHD and SLI. They map out connections that they call the 'major nodes of social cognition' between a variety of typical social cognitions and link these key behaviours in the form of a network (See figure 1.1). So, this gives measures of social cognition that are largely used for research purposes for those with ASD a much wider scope for further research validation on other groups of children with impairments of social cognition.

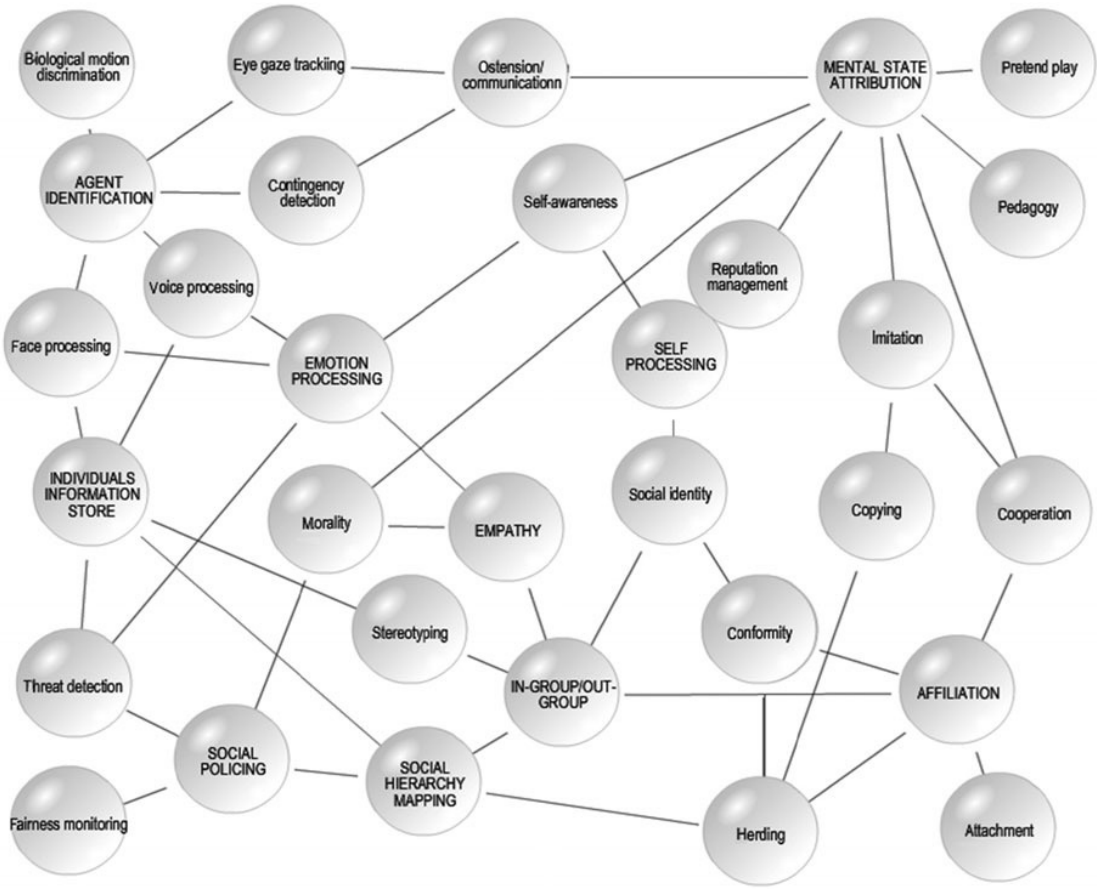


Figure: 1.1: Network map of the major nodes of social cognition, Happé and Frith (2014).

Previous research has observed that children with ASD (and other groups of children) show much interest in technology and computers, and this interest could be harnessed to improve aspects of their learning, due to the fact that enhanced concentration is observed while playing video games (Williams et al., 2002; Tuedor, 2006).

Technology-based interventions have been successful in teaching new skills to children with ASD (Grynszpan et al., 2013; Pennington, 2010; Ramdoss et al., 2011a, 2011b). One of the main priorities are social skills interventions (White et al., 2007), that have been successfully applied to this group (e.g. Beaumont and Sofronoff, 2008; Ramdoss et al., 2012). There is a number of research papers which includes virtual reality with a focus on children and young people with ASD. For example, Beaumont and Sfronoff's (2008) 'Secret Agent Society' which aimed to improve emotional and behavioural skills in individuals with High-Functioning Autism. Beaumont and Sfronoff carried out a randomised control trial which included a range of individual computer-based training in social skills, with some group work and some parental input. The researchers found that post intervention resulted in improvements in social skills in the

playground and classroom. These skills were not directly observed, and, therefore, it has been argued that future research should aim to directly measure social skills in children and, so, focus on the *process* as well as the *outcome* (Golan, Sinai-Gavrilov & Baron-Cohen 2015; Whalen et al., 2010).

Touch screen technology has allowed these social interventions to be accessible to very young children (Díez-Juan et al., 2014; Kagohara et al., 2013; Murdock et al., 2013). This means that the principles of early intervention can now be applied using this technology (Wallace & Rogers, 2010). These are highly motivating and have many rewards for young children. They can also personalise the learning stage and content to suit each child (Fletcher-Watson, 2014). For example, if a child with ASD has difficulties picking up on social cues in their learning feedback, non-social rewards can be more effective (Bedford et al., 2013).

A review article by Wainer and Ingersoll (2011), which included 12 studies discussed technology to support children and young people with ASD. Most of the studies reviewed in this article focused on emotion recognition and simple language skills such as learning vocabulary and reciprocal language. Four of the articles in the review were about social skills and social awareness. For example, Bernard-Opitz, Sriram et al., (2001) utilised static pictures to teach problem solving and asked children to decide on suitable solutions to resolve social conflict. The results demonstrated that children with ASD between the ages of 5-8 years increase the number of conflict solution ideas from one to around 3 over the training period.

Parsons, Mitchell, and Leonard (2004) used a virtual cafe with twelve teenagers with ASD to teach social awareness and then conducted a follow up study with another six adolescents (Mitchell, Parsons, and Leonard 2007). After the completion of the virtual cafe training, participants demonstrated improvement in their social understanding in the setting they were provided with (i.e., choosing seats, knowing when to start a new conversation) as measured by their responses to the video questions. Other similar studies have also shown that participants with ASD can enhance their social understanding using a computerised social training platform (Cheng & Ye, 2010; Herrera et al., 2008). A more recent example of a serious game that has been developed to improve children with ASDs' social communication comes from the ECHOES project, which is a large UK wide project (Alcorn et al., 2011, Bernaedini, Porayska-Pomsta and Smith 2014; Porayska-Pomsta et al., 2011). In ECHOES children are presented with a large LCD display with eye gaze tracking. The children use the large touchscreen to interact with an intelligent

virtual agent or character (named Andy) in the context of a series of social situations which are presented in a colourful and user-friendly fashion for children. One of the key aims of the project was to improve the social interaction through communicating with the virtual character. The children were measured on their joint attention, which can be defined as their ability to direct and share attention by looking towards people or shifting gaze between people. Symbol use was also examined, which is the children's understanding of meaning expressed through conventional gestures, words and more advanced linguistic forms child's ability to conventionally use objects in play; and the child's ability to use non-verbal means and vocalisations to share intentions.

The experimental results of this research demonstrate that the number of social initiations that children make to Andy when children commence the ECHOES intervention is significantly less than the number of initiations that they make to the practitioner, but this disparity disappears by the final session. A possible interpretation of this phenomenon is that Andy's reciprocal interactions with the children and his critical role within the learning activities are responsible for eliciting spontaneous social behaviours in the children. The post-intervention interviews conducted found that teachers and support workers agreed on the improvements to the children's social behaviours. They also felt that observing children interacting with ECHOES and Andy provided them with an unusual and unexpected window onto the individual children's capabilities (Bernaedini, Porayska-Pomsta and Smith, 2014). Thus, this evidence strongly suggests that using computer mediated methods of social communication may be very useful in realising the potential of some groups of children who ordinarily struggle with social interaction.

A general criticism of many of the above studies is that only a limited number have examined performance in social environments that are characteristic of the actual circumstances that individuals encounter in everyday life (Didehbani, Allen, Kandalaft & Krawczyk, 2016). Also, many involve passive social interactions that can be overly scripted without encouraging the spontaneity of everyday conversations. Schilbach et al. (2013) discussed the importance of using real-time social interactions in order to enhance social cognition. This "second-person" approach, which incorporates more than one person engaged at the same time, is needed to understand and improve any social cognitive issues that many children have. Nevertheless, it can be seen that virtual reality and computer mediated interventions have proved successful in improving social skills in children and young people with social difficulties.

A more general criticism of the research on technology and social skills intervention research is that it is heavily focused on those with high functioning ASD, however as mentioned above there are many other disorders of social cognition (Happé & Frith, 2014). It should also be highlighted that ASD is highly comorbid with a number of other disorders (that will be discussed further on in this review). This makes it clear that this line of research is relevant to other groups of children and the field must expand to include evidence that is relevant to these other groups of children.

Because technological advancements very quickly outpace academic research, I believe that the novelty and innovation of up to date technology should not be the main focus of research involving human-computer interaction. Instead, the qualities of the technology that promote positive outcomes (Fletcher- Watson and Durkin, 2014) and relevant psychological theory that tap into underlying concepts of the behaviours and mental processes being measured should be the main focus of the research (Rajendran, 2013), in the same way as, classic studies without technological enhancement have stood the test of time, with impact to influence today's researchers.

With this in mind I will now explain how psychological theory is imperative to the research in this thesis. The overarching theories that this thesis will focus on are social cognition largely focusing on Theory of mind (ToM), and Executive functioning (EF). Both will be discussed in turn next.

1.4: From Story vignettes to computer mediated role-play for measuring children's social understanding.

ToM is the ability to foresee and rationalise other people's behaviour through referring to mental states. It is the ability to correctly attribute beliefs, desires, goals, and precepts to others and being aware that these may differ from your own. ToM is an important skill for success in human interaction and social dynamics emerging in early childhood (Fodor, 1992), as we develop an awareness that others may have different knowledge, beliefs, and goals than our own. ToM is a vital aspect for social interaction, and where ToM does not develop, for example those with disorders such as ASD or reactive attachment disorder, this bestows great challenges (Baron-Cohen, Leslie, & Frith, 1985).

Since Wimmer and Perner's (1983) seminal work, measuring children's social understanding has come from a theory of mind tradition. Arguably, this is an introductory theory of everyday cognition, and the beginning of developing naïve psychology, just like a child's progress with understanding of basic physics and biology for example (Wellman

& Gelman 1998). In the early years of this research (from a developmental psychology perspective) understanding mental states was investigated by testing 3-6-year-olds appreciation of how other individuals' beliefs and desires work jointly to produce intentional behaviour, including those behaviours that are driven by false beliefs (Wellman, 2018).

ToM development has a variety of consequences, such as a significant impact on developing friendships with peers, popularity and the ability to lie and deceive, game playing skills, strategies for persuading and arguing. ToM can predict children's cognitive skills, such as parenting, fluid intelligence, metacognitive strategies, emotional understanding, learning reading and mathematics content, and acceptance of feedback from teachers (e.g. Hughes et al., 2012; Ibanez et al., 2012; Meins et al., 2002; Trentacosta & Izard 2007; Wellman & Lagattuta 2004).

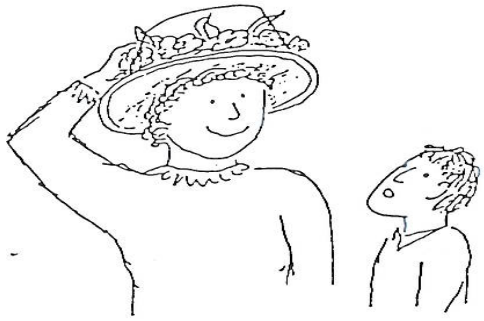
Hughes et al. (2012) have investigated variation in upbringing and environmental influence to identify individual differences. For example, in a large longitudinal study where 1,116 pairs of 60-month-old twins took part, it was found that 44% of the variation in ToM scores could be explained for by ToM specific nonshared environmental influences, 20% by ToM- specific shared environmental influences and 21% by common shared environmental influences. In particular shared environmental influences on verbal ability had a common impact on ToM and it is thought that factors influencing these findings may include maternal speech and mind-mindedness, and social interaction from siblings and peers.

Studies have also identified that, for many autistic individuals, the understanding and interpretation of others' social and emotional behaviours is minimal and may continue to be so throughout the lifespan (Jarrord, Butler, Cottingtin, & Jimenez, 2000), leading to many challenges when faced with day to day social interactions.

These challenges with social interaction have been measured in a number of ways, from using dolls (e.g. Baron-Cohen, Leslie & Frith, 1985), to advanced theory of mind measuring story vignettes (e.g. Happé, 1994; Rajendran & Mitchell, 2007). Happé's 'Strange Stories' are simplified narratives of everyday scenarios followed by questions that assess the participants understanding of nonliteral language in the format of short stories (including measures of sarcasm, figures of speech, white lies, etc. (See Figure 1.2). Versions of these stories have been shown to discriminate developmental stages (e.g. O'Hare et al., 2009) and between those who do and do not have ASD. Those who passed

2nd order ToM tasks gave incorrect responses to some of the strange stories (Hàppe 1994; Jolliffe & Baron-Cohen 1999).

'One day Aunt Jane came to visit Peter. Now Peter loves his aunt very much, but today she is wearing a new hat; a new hat which Peter thinks is very ugly indeed. Peter thinks his aunt looks silly in it, and much nicer in her old hat. But when Aunt Jane asks Peter, ''How do you like my new hat?'' Peter says, ''Oh, it's very nice''.



1. Was it true what Peter said?

2. Why did he say it?'

Figure: 1.2: Example 'Strange Stories' 'White Lie'. (Hàppe 1994; O'Hare et al., 2009). 81

There is much evidence from studies using false belief tasks (Wellman, 2002) that 4-5-year-olds begin to develop a ToM and, by age 6, they should have a good grasp of first-order ToM skills (Wellman, Cross, & Watson, 2001). First-order ToM is routinely examined using a false belief task – one such example is the unexpected contents task. For example, a child is shown the contents of a box of plasters and an unmarked plain box. The plasters are in the unmarked box and the plaster box is empty. The adult introduces the child to a puppet and asks the child to predict where the puppet will look for the plasters. During middle childhood, ToM abilities become more elaborate and complex, and children typically acquire the ability to solve second-order ToM tasks. Second-order ToM abilities require the child to understand that his/her beliefs about other people's beliefs can be wrong, and studies of these abilities invariably involve complex stories given to the child (Astington, Pelletier, & Homer, 2002; Happé, 1994).

First-order ToM abilities are said to be a good predictor of social skills (Jenkins & Astington, 2000), equivocal evidence has been reported from other studies. Dunn (1995) found that competent false belief understanding at age 3 was related to reports of

behavioural and peer difficulties at age 6. Specifically, children reported problems in making and keeping friends, and avoiding social activities with peers. In contrast to popular belief, it was the children who were slower to acquire ToM abilities that reported greater peer popularity. Yet others have reported that children who have ToM deficits have problems with peer rejection and show heightened aggression (Hughes, Dunn, & White, 1998; Peterson & Siegal, 1995). Some studies (e.g., Happe & Frith, 1996) have not found any differences in first-order ToM abilities between "normally" developing children and children with conduct-disorders, who typically have problems with aggression and are rejected by peers.

Despite the popularity of story vignettes, it is argued that most of the experimental paradigms designed to assess ToM abilities involve fairly well developed expressive and receptive language skills, which can cause issues, since many groups of children have poor verbal abilities (Colle et al. 2007). Thus, failure on such tasks may in fact reflect participants' inability to comprehend task instructions, as much as deficits in mental-state understanding (Frye et al. 1995; Astington 2001).

As such other novel approaches have been suggested, for example; Sivaratnam, Cornish, Gray, Howlin and Rinehart (2012) successfully validated a colourful comic strip ToM measurement tool that better relies on non-verbal abilities to facilitate children who suffer from language related impairments. The success of this type of task relies on clear visuals such as the characters changing emotions and changing scenes presented in each scenario to help the children follow the story with ease in a non-verbal way.

Despite this Rajendran and colleagues (Rajendran & Mitchell, 2000; Rajendran, Mitchell & Richards, 2005) argued that such tasks (verbal or nonverbal) measure children's *reflective* rather than *working* understanding and that computer role-play offers a truer indication of children's understanding. Computer role-play offers the chance of putting 'oneself in another's shoes' and potentially having to simulate (Harris, 1992; Jones, Price & Selby, 1998), what a character might do in a hypothetical situation. Thus, Rajendran, Mitchell and Rickards (2005) proposed that role-play would be an ideal platform. With the use of a program called 'Bubble Dialogue' (Gray et al., 1991). Rajendran, Mitchell and Rickards (2005) investigated non-literal language and inappropriate request in people with Asperger's syndrome. They used computer role-play versions of Happé (1994) measures of sarcasm and figures of speech, amongst other things, they discovered that adolescents with Asperger's syndrome took to computer-mediated communication very well, taking on the role of the characters with ease.

Contrary to Happé (1994), this study provided evidence to suggest that a lack of ability to understanding non-literal language of figures of speech was not necessarily a social issue specific to those ASD. It is likely that individuals with ASD took to the more practical computer role-play measure better that they would have the 'strange stories' or a person-centred role-play task, due to them feeling more comfortable with using computers as a mode of communication. Computer mediated role-play using 'Bubble Dialogue' was also found to be useful with other groups of children including those with emotional and behavioural difficulties and typically developing children (Jones et al., 1998). Jones and colleagues found that computer mediated role-play helped children to more easily express themselves and convey information form their own perspective.

This is in contrast with the story vignette paradigm in which a child might feel under pressure to give the correct or most appropriate answer (Seigal, 2004) or have to work the correct answer in more abstract or 'theory theory' type way (e.g. Chapman, 1988). In role-play, social interaction is used as the incentive to encourage the emergence of a child's beliefs about the world around them (Piaget, 1972) meaning that role-play is very relevant for social learning (Henriksen, 2004) and measurement of social behaviours. The elevated level of drama in role-play approaches, such as Theatre in Education (Jackson, 1993) and Forum Theatre (Boal, 1979), result in an immediacy that is more likely to evoke emotion and true to life thinking, than other approaches (van Ments, 1983). The basic premise of role-play is that it is easier to empathise with how another person might feel under certain circumstances if one has experienced something similar, even symbolically as part of role-play (Robertson & Oberlander, 2002).

Another advantage of using computer role-play technology is that it is immersive – that is it can give players a sense of "psychological presence" of being there (Tamborini & Skalaki, 2006) and identity (Gee, 2014). Presence is important because the greater the degree of presence, the more chance that participants will behave in a VE, in a manner which is comparable to their behaviour in the "real world". Arguably, presence brings into play "natural" responses to a situation (e.g. Slater & Wilbur, 1997). Computer mediated role-play has been used for a variety of research purposes, over the years for example language learning (Prendinger & Ishizuka, 2001) and educational storytelling, for example, Ghostwriter (Robertson & Oberlander, 2002), Teatrix (Machado & Paiva, 2001), and Virtual Puppet Theatre (Andre, Klesen, Gebhard, Allen, & Rist, 2000). The potential of computer role-play for social and emotional learning has also been explored to some extent (Gratch & Marsella, 2001; Marsella & Johnson, 2003). This platform

provides children with a safe environment for experiential social and emotional learning (Aylett, Paiva, Woods, Hall, & Zoll, 2005; Paiva et al., 2004), and allows the user to experience the character's problems in a distanced way, while still being engaged in what happens to the character from a first-person perspective. According to Schilbach, Eickhoff, Cieslik, Kuzmanovic, and Vogley (2012), it is important to be engaged in the social interaction (online social cognition) rather than passively observing a social interaction. These authors argue that "online" social cognition involves an integrative understanding of social perception and reciprocal communication, which is difficult for those who find communicating with others challenging and who often succeed at "offline" social cognitive tasks (i.e. making social judgments based on static stimuli or observation).

Using computer mediated role-play provides this 'online' social cognition which will allow children to understand social interactions from a first person rather than from a third person perspective. Indeed, there is increasing appreciation of the potential of computer-assisted role-play environments as effective, appropriate, engaging, tools (Imholz, 2008). These platforms provide virtual learning environments (VLEs) populated by synthetic/digital characters engaged in role-play scenarios that can offer users safe and compelling access to real-world social and emotional experiences (Dautenhahn, Bond, Canamero, & Edmonds, 2002).

Interdisciplinary work has produced prototype tasks for measuring children's social understanding, for example, using a virtual role-play program called 'FearNot!' (E.g. Aylett, Paiva, Woods, Hall, & Zoll, 2005; Paiva et al., 2004; Hall, Woods & Hall; 2009). Here, ToM methods were used to gain insights into children's (N = 345) abilities to correctly attribute beliefs, desires, goals and precepts to others, through a virtual role-play task about bullying in which the participants were 'synthetic characters' (i.e. computer generated), rather than actual children undergoing a real bullying experience. The child participants role-played a third character that played a "friend" who gave the victim advice after they had viewed the bullying scenario. This advice was then used to measure the child participant's social understanding and Theory of Mind. Thus, it is clear to see that computer role-play is a fruitful tool for assessing children's social understanding.

Another example is Story Maker ^{TM} (Kokiana & Kern, 2010) that offers a way to directly measure social skill development by shifting away from "paper pencil" outcome measures to computer role-play. This digital measure also means that hundreds of social

stories can now be stored on a single device. Despite this methodological advantage, convenience and portability, the effectiveness of this particular method for intervention purposes was low. There have been – to date – no direct comparisons between performance on social story apps and traditional "paper pencil" formats.

As well as computer role-play being a useful tool for assessing and improving children's social and emotional understanding from an educational perspective, it can be utilised to measure other social behaviour in children. It is thought that the more immersed the child is in the task at hand (forgetting about the researcher or clinician being there) will likely help with yielding responses from the children which are truer to how they would behave in the 'real world', which could, for example, be very useful in the assessment of disinhibited behaviours or attachment related issues (which will be discussed in more detail in the next section of this thesis) that can cause children to be at risk of accidental injury or child abduction. On this note, role-play technologies allow researchers to place participants in scenarios that would otherwise be deemed unethical if they were carried out in the real world, with the technology offering a safer more ecologically valid environment.

In infants, attachment issues are most commonly measured using the 'Strange Situations' procedure (SSP: Ainsworth, 1979), although, the SSP is not appropriate for measuring attachment difficulties in older children, which has proved to be notoriously difficult (e.g. Minnis et al., 2010). One task that does reliably measure attachment issues in middle childhood, however, is the 'Manchester Child Attachment Story Task' (MCAST: Green, Stanley, Smith, Goldwyn, 2000). This is a representational procedure for assessing attachment patterns of young school aged children. The task is based around a doll's house and after hearing a story from the task administrator the child participant then takes on the role of a doll to complete the scenario (i.e. the child represents themselves through the doll).

Minnis et al. (2010) developed a computerised version of the MCAST (the CMCAST), that can be used on any standard computer. Story stems are represented on the computer by the movement of two-dimensional 'dolls' narrated by a generic voice. Children then take control of the task and complete each story by speaking into the computer; the audio-visual data produced by the child can be downloaded for later rating. The findings revealed that the CMCAST had similar reliability and validity to the MCAST and yielded further benefits. For example, it is easier to administer for large sample epidemiological studies, reduces reliance on trained researchers in task

procedures, less exhaustive involvement of the researcher, has the potential to yield truer more ecologically valid responses, and is slightly cheaper to administer than the MCAST.

The ideas discussed here will be further explored in chapter 3 of this thesis.

1.5: The role of Executive Functioning

Executive functioning (EF) is an umbrella term for the abilities needed when we are working in a motivated manner to reach goals which may be challenging (Gillberg & Coleman, 2000). Executive functions include inhibition, cognitive flexibility, generativity, self-monitoring planning and problem solving (e.g. Hill 2004; Rajendran, 2013). In recent decades, there has been a focus on atypical development e.g. executive dysfunction, in ASD and ADHD, establishing group norms in EF psychometrics (e.g. Barkley 1997; Craig et al., 2016; Gioia, Isquith, Guy & Kenworthy 2010; Gioia, Isquith, Kenworthy & Barton 2010; Happé, Booth, Charlton; Hughes 2006; Schmitz et al., 2006). Also, looking at individual psychological mechanisms and neural substrates of EF and focus on the cognitive and academic correlates of individual differences in EF (e.g. Best, Miller & Jones 2009; Dimond & Lee 2011). Research also differentiates between 'cool' and 'hot' EF. Cool EF can be defined as the cognitive skills that are traditionally thought to encompass EF, such as inhibitory control and cognitive flexibility, when employed in emotionally neutral situations (Zelazo & Muller 2002).

On the other hand, it is suggested that hot EF includes affective decision making and delayed gratification (Carlson, Zayas & Guthormsen 2009; Zelazo & Carlson 2012). There is much evidence to suggest that EF develops quickly around the ages of 3-5 years old, with adult-level performance being achieved during puberty (Anderson, 2002; Zelazo et al., 2003). The development of EF is sustained by the development of the prefrontal cortex in young children (Diamond, 2002; Durston et al., 2006; Moriguchi and Hiraki, 2009).

We know there is a clear link between social interaction and EF, but much less emphasis has been placed on this in recent decades. Historically, however, the Vygotsky-Lurian tradition placed importance on the role of social processes in executive control and attention skills (Carlson, 2009). Vygotsky (1978) believed that the development of EF came from social interactions, in particular, language. Here social interaction is the mechanism for the diffusion of the cultural tools of language and related symbol systems that are involved in the ability of executive control.

Even earlier than this, developmental theorists considered that self-control develops through distancing oneself from reflective proponent responses and increasing reflections and deliberations of alternative possible responses (Baldwin, 1892; Mead 1910). With symbolic thought it is possible to achieve "psychological distancing" and respond in light of the symbol, rather than the stimulus itself (Sigel,1970, 1993).

There has been a recent revival of this area in the last decade, with many researchers in the field now considering the role of social interaction when researching EF (Lewis & Carpendale 2009). Much of this perspective and the relevant evidence focuses on early development and social interaction between the parents and the child.

Roskam et al. (2014), suggested two dimensions of how the interaction between parents and children influences EF in later development: supportive parenting and negative control. Supportive parenting includes scaffolding, acceptance, and autonomy. It is believed that these facilitate children's development of EF to some extent. Indeed, Landry et al. (2002) demonstrated a link between parental verbal scaffolding and EF skills. The EF skills included, search retrieval that is mediated by children's verbal and non-verbal problem-solving abilities. Bernier et al. (2010) found an influence of maternal sensitivity, mind-mindedness and scaffolding at 1 years old predicted children's EF skills, such as set shifting and working memory. Sensitivity in this context is the propensity to read the child's needs and react aptly (Ainsworth et al., 1978). Interestingly, the results revealed that scaffolding was a strong predictor of the development of EF. Additionally, maternal scaffolding and other factors such as imitative learning, play an important role in the development of EF (Hughes and Ensor 2009).

The second dimension, negative control is related to parenting that involves punishment. Research has constantly demonstrated that such parenting may lead to children's negative behaviours in later development (Gershoff, 2002). In relation to EF negative control parenting can have an adverse impact on children's EF skills in later years, including poorer inhibitory control skills Roskam et al (2014). Likewise, positive (e.g., sensitivity) and negative (e.g., intrusiveness) parenting during infancy influenced EF and IQ in later development (Blair et al. 2011). Thus, suggesting that negative parenting may make it difficult for children to learn to control their actions.

As well as their being an effect of social communication between parent and child, it is important to also acknowledge the importance of the interaction with peers and EF ability. Certainly, collaborative learning has been reported to enhance cognitive

development, indeed these ideas go back to traditional Piagetian ideas (Doise and Mugny, 1984). In collaborative learning, each individual can have a different outlook in a given tasks, including social conflict. There are several reasons why peer collaboration can improve a child's EF. For example, children may be aware of task goals and can be facilitated in reaching the goal through another person's perspectives during collaboration, which can lead to more effective EF skills Qu (2011).

Research has established that children "overimitate" the behaviours of others (Horner & Whiten, 2005; Lyons et al., 2007; McGuigan, Whiten, Flynn and Horner, 2007). Overimitation is a child's tendency to mimic the obviously irrelevant actions of adults. For example, Horner and Whiten (2005) compared the performance of chimpanzees and 3 to 4-year-old children who in the experiment observed a demonstration of the researcher using a tool to gain a reward from a complex box structure. Some of the actions made by the researcher were directly relevant to obtain a reward, but others were obviously irrelevant. Whereas chimpanzees only reproduced relevant actions, human children were more likely to reproduce both the relevant and irrelevant actions. This line of research suggests that social and imitative behaviour can be a rather powerful force as such children can fail to control their social behaviours after learning them from an adult.

More to the point, this leads us to the evidence that suggests that this social learning (or imitation of another's actions) can influence a child's EF abilities. Indeed, Moriguchi et al., (2007) investigate this by employing a modified version of the Dimension Change Card Sort (DCCS). In this version of the task 3-5-year-old children watched the experimenter sorting the cards according to one dimension (shape) During the next stage, children were required to sort according to the other task dimension (colour). The findings revealed that most 3-year-olds sorted the cards according to the first observed dimension (shape), despite being instructed to sort by colour. Nevertheless, just over half of the 4-year-old children and the majority of 5-year-old children did not use the observed rules and sorted the cards according to the instructions. It is widely accepted that culture is learned through imitation, and positive imitation appear to be better for improving children's EF and vice versa (Morigauchi, 2014).

Thus, as well as the social world having an influence on EF Skills it is also important to highlight that this goes in both directions and research also demonstrates that a child's social understanding could be mediated by EF skills and thus able to influence a child's social interaction skills. In particular it is well established that EF is a significant

correlate of ToM understanding (Frye et al., 1995; Hughes, 1998; Carlson and Moses, 2001; Sabbagh et al., 2006; Benson et al., 2012).

It is believed that the development of false belief understanding may contribute to improvement in children's EF (Perner et al., 2002). Here it is proposed that the meta-representational understanding underlying ToM provides the foundations for developing EF skills. Likewise, Kloo and Perner's (2003) findings revealed that training children on ToM tasks can improve performance on the DCCS task. Other research highlights that DCCS training also improves children's performance on ToM tasks. Indeed, interesting insights from longitudinal research have demonstrated that EF skills (around 2 years of age) can predict later ToM abilities (i.e., at 3 years of age) rather than the other way round (Carlson et al., 2004), which is contrary to the research that suggests that ToM predicts EF.

The above links back the earlier argument that computer mediated role-play can be a fun and engaging way to mimic everyday social interaction because it allows children the motivational control or self-regulation they need to successfully complete the task at hand, as it gives children a reason for wanting to exert control over the self (Carlson, 2009; Mede 1934). Arguably, when children take part in tasks where they are motivated and can easily keep track of the story, they will be cognitively motivated and, thus, display improved executive abilities and task performance (e.g. Durkin, 2010).

It seems possible that social interaction and EF are intrinsically linked and may be key to successfully navigating our social world. This will be explored further in later sections of the general introduction and in chapter 4 of this thesis.

1.6: Disinhibited Social Engagement/Indiscriminate Friendliness

The measures created to carry out the research in this thesis can be used as a general measure of social vulnerability in middle childhood, I created the 'paper and pencil' stories and computer role-play scenarios for this thesis with a more extreme clinical population of vulnerable children in mind, in order to capture the nature of vulnerable behaviours more accurately.

Specifically, Disinhibited Social Engagement Disorder (DSED or DSE) or indiscriminate friendliness (IF) is a highly prevalent trauma and stressor related disorder. DSED is described in the DSM-V, (APA, 2013) as a pattern of behaviour in which a child actively approached and interacts with unfamiliar adults, DSED is a tendency to be unduly affectionate and disinhibited towards others. This behaviour can cause children to

be vulnerable to social issues such as ‘stranger danger’, child abduction and/or abuse, which are among the most common offenses committed against children, and as such this has implications for protecting all children and young people who display symptoms of social vulnerability (NSPCC, 2014). In some populations, this disorder is present in approximately 20% of children (DSM V, APA, 2013).

Research in this area is still relatively young and the field has seen a new surge of interest in recent years. As such multiple terms (old and new) are used to describe the same behaviour patterns, and researchers and clinicians are still understanding the classification and etiological pathways of the disorder and related behaviours. The exact nature of these issues will be discussed along the way in the present chapter. Due to the DSM-V being published only months before the present research thesis commenced research specific to DSE behaviours is hard to come by, (although a resurgence in this field means that this continues to improve). I will, therefore, begin by taking a broader approach to this general research area.

The research in this field is largely derived from longitudinal studies of children adopted after severe social deprivation in the early years of their life while institutionalised in Romanian orphanages. These children show a high prevalence of intrusive and indiscriminate social behaviour, which at the time was labelled Disinhibited Attachment Disorder DAD (O’Connor, Bredenkamp & Rutter, 1999); the behaviours are persistent throughout childhood and adolescence. Certainly, children who are initially raised in orphanages and then adopted in loving families typically show improvement in physical growth, stereotyped motor movements, cognition, and attachment (Beckett, Castle, Rutter, & Sonuga-Barke, 2010; Bos, Zeanah, Smyke, Fox, & Nelson, 2014), but DSE is reported by parents years after the adoption has occurred (Chisholm, 1998). For example, in the English and Romanian Adoptees (ERA) Study, where DSB was measured using both parent questionnaires and ratings of the child interacting with the investigators, 54% (88 adopted infants and toddlers) were demonstrating DSE at age 6 and age 11 (Rutter et al., 2007) and 33% still demonstrated DSE at age 15 (Kreppner et al., 2010). This suggests that adverse circumstances as an infant can have a profound long-term effect and traditional interventions such as placing the child with an adoptive caregiver does not seem to be sufficient. Thus, it is necessary to find another intervention for these behaviours out with the attachment framework. DSE is also associated with psychopathology, functional impairment, and high levels of social and clinical service use (Kreppner et al., 2010; O’Connor, Rutter, & The English and Romanian Adoptees

Study Team, 2000; Rutter et al., 2007). DAD has previously been understood as an attachment disorder. The DSM-IV (1994) childhood diagnosis reactive attachment disorder (RAD) had two subtypes: emotionally withdrawn/inhibited and indiscriminately socially disinhibited. In DSM-V (APA, 2013), these subtypes are defined as separate disorders namely; reactive attachment disorder and disinhibited social engagement disorder. At the time, the DSM-V was written both of these disorders were considered to be the result of social neglect or other situations that limit a young child's ability to form discerning attachments. The disorders differ in that due to lower positive affect, RAD more closely resembles internalizing disorders in the sense that children become socially withdrawn and avoidant. It is in essence equivalent to an inability to form secure attachments to caregiving adults.

In contrast, disinhibited social engagement disorder more closely resembles Attention Deficit Hyperactivity Disorder (ADHD); it may occur in children who do not necessarily have attachment issues. Evidence suggests that ADHD and DES have discriminatory features, indeed, research suggests that although both those with DSE and ADHD both display symptoms of IF, they differ in that DSE or IF is an attempt by the child to win approval from adults they perceive to be important, or to control a situation they feel is unpredictable. Whereas, in ADHD it may be simply be a function of impulsivity (APA, 2013). Similarly, another issue is discrimination between RAD and ASD due to overlapping social relationship issues. Recent research by (Lehmann et al., 2015) has confirmed robust support for the DSM-V conceptualisation of RAD and DSED as separate dimensions of child psychopathology. This suggests that more research on the nature of DSED is warranted.

Like ADHD, ASD is a neurodevelopmental disorder whereas RAD is associated with maltreatment or neglect (genetic v's environmental causes respectively), therefore, accurate differentiation is crucial. At present this area of research acknowledges that both groups of children share difficulties with social communication and moderating social behaviour. Some research suggests that children with a diagnosis of RAD have poorer quality social relationship outcomes than those with ASD (Davidson et al., 2015). This research has confirmed that parent report measures demonstrate children with ASD had fewer IF symptoms than those in the RAD group, interestingly the majority of the sample in this research study were of the disinhibited type of RAD (bar one participant) meaning that under the present DSE classification this research is highly relevant to the current

thesis in highlighting the urgency of extending social understanding and social skills research beyond ASD populations.

Interestingly, a review of the evidence argued that DSE should be considered a separate disorder, resulting from an environment of social neglect or maltreatment, but should not be limited to children who display poor attachment relationships as attachment issues do not appear to be the main cause of the behavioural symptoms displayed in these groups of children (Zeanah & Gleason, 2010). The recent reconceptualisation of this disorder has highlighted the current need for more detailed understanding of these pervasive social impairments underlying symptoms of DSED which is important not only for conceptualisation of the behaviours but also for the development of new approaches to assessment and intervention (Smyke et al., 2012).

Thus, research that predates DSM-V, uses DSM-IV terminology. This means that DSE can be referred to as DAD, and can also include studies where the children with DSE are researched under a diagnosis of RAD. The research in this field is not exclusively limited to research on these specific diagnostic categories. There is much research which simply focuses on a variety of different groups of children who have at some point in their early life experienced neglect and/or maltreatment which is a key factor in the current diagnosis of the above diagnostic classifications. Typically, these studies (which I discussed in detail in the next section) focus on children who are living in institutions, institutionalised and then subsequently adopted or those who are in foster care. In the vast majority of cases children are placed in foster and kinship care due to maltreatment or neglect. Interestingly some research suggests that those with RAD may respond better to social-educational interventions in comparison to those with ASD (Mukaddes, Kaynak, Kinali, Besikci, & Issever, 2004).

1.7: Measuring IF/DSE

Currently, our knowledge of disinhibited social behaviour in children is largely derived from caregiver reports, observational and qualitative research (Bennett, Espie, Duncan, & Minnis, 2009; Bruce, Tarullo, & Gunnar, 2009; Lawler, Hostinar, Mliner, & Gunnar, 2014). This research generally focuses on DSE in infants because measuring this level of social behaviour accurately in middle childhood has proved challenging for both clinicians and researchers (Minnis, Read, Connolly, Burston, Schumm, Putter-Lareman & Green 2010).

An early tool that is currently still in use is the Disturbance of Attachment interview (DAI: Smyke & Zeanah 1999). This is a semi-structured interview designed to be administered by clinicians to caregivers who know the child and the child's behaviour well. Like the majority of current measures, however, it has been created to capture the symptoms of Reactive attachment disorder and predates DSM-V meaning only four items from the DAI measure DSED. The four items are failure to check back in unfamiliar places, lack of reticence with unfamiliar adults, nonaggressive physical contact with strangers, and willingness to go off with a stranger. Items are typically followed by specific examples and allow the interviewer to investigate behaviours typical of children of various ages and developmental levels. The DAI has been utilized across a wide age range including older children (Humphreys, Nelson, Fox, & Zeanah, 2017) and adolescents (Elovainio, Raaska, Sinkkonen, Makipa, & Lapinleimu, 2015).

In the English and Romanian Adoptees (ERA) Study, measured DSED using both parent questionnaires and ratings of the child interacting with the investigators. Behavioural observations have also been used in a number of studies (e.g. Bruce et al., 2009 Gleason et al., 2011; Lyons-Ruth et al., 2009 O'Connor et al 2003) and are associated with parent report measures (Gleason et al., 2011; O'Connor et al 2003). In terms of research assessment, several studies have coded IF through a modified version of the Strange Situations procedure (Lyons-Ruth et al., 2009; O'Connor et al., 2003) or other structured stranger interactions (Bruce et al., 2009)

There is little consensus on how to code IF behaviours in such observations. Lawler, Hostinar, Milner and Gunnar (2014) utilised a developmental psychopathological approach (Cicchetti, 1984) to study IF, by comparing it to normative social development and by studying its patterns over time in 50 newly adopted post institutonalised children (16-36 months at adoption) compared with 41 children adopted early from foster care overseas and 47 non-adopted controls. Coded behaviours of the children's contact with an unfamiliar adult and atypical behaviour were distinguished from normative behaviours. By using principle components analysis, the researchers identified two dimensions of social disinhibition: *nonphysical social dimensions* and *displays of physical contact*. The non-physical social dimensions showed wide variations in the control children and the authors, therefore, suggest that this can be considered a typical form of sociability. Displays of physical contact and intimacy were rare in the control group children, suggesting that they represent an atypical pattern of behaviour. Both

adopted groups of children demonstrated more physical IF behaviour than the control group, but there were no group differences on the non-physical factor.

Bennett et al. (2009) conducted a qualitative study on themes related to IF; eight young people (aged 9–14) were interviewed about indiscriminately friendly behaviour. The majority of the sample had a history of maltreatment and placements within foster and other care settings. These young people were described as indiscriminately friendly by clinicians, guardians and via the Relationships Problems Questionnaire (RPQ). Interview transcripts were analysed using Interpretative Phenomenological Analysis (IPA). Emergent themes were drawn from interview data, which highlighted the young people's experiences of rejection and feelings of insecurity within their social interactions. While being aware of the risks associated with speaking to strangers and the efforts of adults attempting to protect them from the potential danger associated with indiscriminate friendliness, this group of young people demonstrated an atypical trust of new people and a strong craving for kindness from others. Evidence was also collected which showed that these children attempted to exert control over others during social contact.

For children of all age groups studies have used parent interviews, which collect information about everyday situations across a variety of settings these methods are relatively inexpensive, and time efficient, however the behaviour of each child is not measured directly. There is currently no caregiver/teacher measure that is purely for assessing DSED, but instead these behaviours are measured along with the behaviours of RAD in general. One questionnaire that is widely used is the Relationship Problems Questionnaire (RPQ), there are both parent and teacher version of the RPQ. The Relationship Problems Questionnaire (RPQ) is a parent-report questionnaire for RAD symptoms (Minnis, Rabe-Hesketh, & Wolkind, 2002). It has four possible responses ('Not at all like my child', 'A bit like my child', 'Like my child' and 'Exactly like my child') scored 0, 1, 2 and 3 respectively. In a large general population sample, the RPQ had good internal consistency (Cronbach's alpha .85) (Minnis et al., 2007). A teacher version has also been developed. The internal consistency for the teacher RPQ had an excellent internal consistency of .92 (Cronbach's alpha) (Minnis et al., 2009).

Another well-established parent report is the DAWBA-RAD (Minnis & Goodman, n.d) this is a questionnaire form of the Child and Adolescent Psychiatric Assessment – Reactive attachment Disorder (Minnis et al 2009). The DAWBA-RAD consists of 24 items operationalized from ICD-10 criteria for inhibited and disinhibited

subtypes of RAD that successfully identified RAD in looked after children within a wide-ranging UK population survey of child mental health (Meltzer, Gatward, Goodman, & Ford, 2000), along with additional items discriminating RAD from other psychopathology in a large UK twin epidemiological study (Twins Early Development Study; Minnis et al., 2007). The DAWBA-RAD was also used to describe RAD in a sample of 153 adolescents living in care in the United Kingdom, identifying DAD subscales using exploratory principal components analysis (Kay & Green, 2013). Kay and Green (2016) carried out one of the first studies in the UK to specifically look at DSED or disinhibited attachment disorder (DAD) as it was previously known. In this study, they also used a measure of reactive attachment disorder. Here they split the items up and focused on responses to items related to disinhibited indiscriminate behaviour and superficial relationships.

These parent interviews and questionnaires may, however, be subject to reporter bias, particularly when comparing DSE with other parent-reported concerns, such as behaviour problems (Lawler, Hostinar, Milner, & Gunnar, 2014). Thus, as of yet there is no quantifiable way to directly observe the actual behaviours of older children. In the present thesis, I aim to address this. Fraser, (unpublished masters 2010) created a novel measure of IF for older children, in the form of vignettes, the style of these stories being modelled on the 'strange stories' (O'Hare 2009). The vignettes were compared between 30 maltreated adopted children and 36 children raised in birth families who had not experienced maltreatment (7-13-year-olds). The maltreated children performed more poorly than the non-maltreated children in comprehending and explaining why people might be indiscriminately friendly. Further, the maltreated children (but not the non-maltreated children) gave responses that were rated as 'extreme' (e.g., involving murder or robbery). There were some limitations to this research which lead it to be unpublishable, for example, the measure was based on the qualitative themes of IF in the Bennet et al., (2009) paper, the issue with this being that not all themes identified were directly centred around IF and the study included a number of "subthemes" which broadly surrounded IF behaviour such as trust, rejection and relationship insecurity's (see figure 1.3). Rajendran et al. (unpublished) vignettes captured a variety of these themes, and thus cannot be considered as a "pure" measure of IF. This study also took a developmental psychopathological approach across a wide age range of participants in the first instance, meaning that the norms of how IF/DSE develops in the typical population have not yet been established, making it difficult to make generalisations to atypical populations. The

current thesis aims in part to address these shortcomings and move beyond vignettes to better capture the children's behaviours.

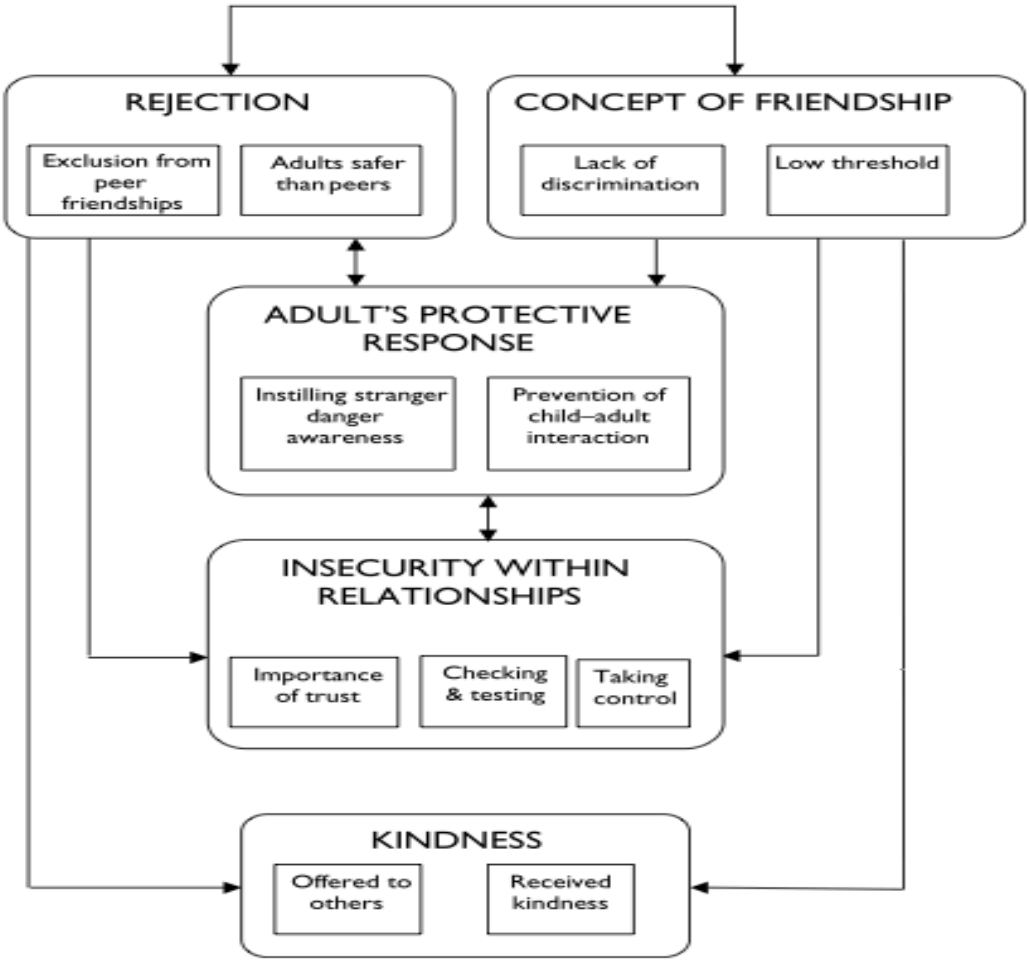


Figure 1.3: Diagram of IF themes from Bennet et al., (2009)

The majority of research to date has focused on exploring IF in children who have been maltreated (Neglected or abused), institutionalised and children who have been fostered or adopted. It is important for research to differentiate atypical responses to strangers from behaviours that may overlap with normative variation in friendliness and studying the developmental course of these behaviours would be an important next step for research in this area (Lawler, Hostinar, Milner, & Gunnar, 2014).

1.8 Social cognition and executive function in DSED

As discussed earlier, the underlying theoretical background of this thesis is concerned with social cognition and executive functioning. I will now discuss the current

evidence basis of possible impairments in these functions in children with DSED and related groups.

During the first months of life, babies engage in social interaction with almost anyone. By 7-9 months, being cautious of strangers is expected. From an evolutionary perspective, uneasiness around unfamiliar adults is an important strategy to encourage survival (Simpson & Belsky, 2008). Provence and Lipton (1962) were among the first researchers to observe the development of infants brought up in institutions and reported that they did not see any evidence of the children having increased personal attachment to any individual and that institutionalised infants responded with equal delight to everybody who came into close proximity with them. This type of evidence was critical to the acknowledgment that the role of early social experiences and responsive care from a caregiver predicts positive social development in adolescence (Jaffari-Bimmel, Juffer, van IJzen- doorn, Bakermans-Kranenburg & Mooijaart, 2006), therefore, these positive social behaviours develop early, and can have long lasting implications.

A key topic in this research area is exploring the deficits that occur when children do not receive an adequate amount of parental care in the early years. As mentioned above many children who experience maltreatment or neglect are at risk of developing DSED, although because maltreated children are a heterogeneous population this is not the case for all (Luke & Banerjee 2013). A wealth of research suggests that childhood maltreatment may predict difficulties with social understanding (Kay & Green 2016; Luke & Banerjee 2013a; Pears & Fisher 2005). Social understanding is a broad team which can include a number of complex skills from early joint attention to the understanding of emotions, false beliefs and then ToM) which develop gradually in young children in the context of social interactions (Carpendale and Lewis 2004). One argument is that the developmental effects of maltreatment are related in the wider context of the child's relationship with their parents (Bornstein 2002).

As discussed in the themes of the research by Bennett et al., (2009) young people who have been maltreated have problematic peer relationships which could be partly rooted in problems with social understanding (Luke & Banerjee, 2013a). Indeed, this is supported by the research which suggests that social understanding predicts positive and negative aspects of peer interaction (e.g., Banerjee, Watling, & Caputi, 2011; Dunn & Cutting, 1999; Hughes, 2011). Luke and Banerjee (2012) interviewed foster carers, and the findings suggest that social understanding as a mediation model is a convincing explanation for the complex social behaviours that carers observe in the everyday

experiences of maltreated children. If typical development occurs in an average expectable environment where children have social interactions with nurturing adults, then maltreatment and the associated behavioural outcomes come from an atypical environment where the development of the skills necessary for social understanding may be diminished. Thus, giving the present thesis more evidence to justify investigating issues with social cognition in relation to IF.

This area of research has largely focused on Theory of Mind and executive functioning, in particular inhibitory control. Research which specifically measure social and cognitive abilities in children with DSE will be discussed further on in this section, however, the story begins with research based on the at-risk groups described above. For example, there is much evidence to suggest that children who have been neglected, maltreated, institutionalised or in foster care have social and cognitive deficits that may be associated with DSED.

The first notable study to investigate this was carried out by Cicchetti et al. (2003) who investigated false belief understanding in children who had experienced maltreatment in two groups of children whom had not been maltreated, namely low and middle Socioeconomic Status (SES). They establish that, when age, language abilities, and SES were controlled for, maltreated children were significantly poorer on measures of false belief than children in the other two groups, thus supporting a link between maltreatment and theory of mind. Furthermore, they found that maltreatment occurring when children are toddlers was linked to larger deficits in false belief understanding than when maltreatment occurred in other periods of childhood. This suggests the toddler period may be important for ToM development. Finally, they found that children who suffered physical abuse presented with poorer theory of mind abilities when age, language,

Pears and Fisher (2005) investigated differences in two areas that may be associated with many of these outcomes, emotion understanding and theory of mind, in a sample of 60 3-5-year-old maltreated children in foster care and a comparison group of 31 age-matched, low-income, non-maltreated children living with their biological relations. Being in foster care was significantly associated with worse emotion understanding and theory of mind capabilities, even when accounting for age, intelligence, and executive function. The length of time in foster care or number of transitions was not a significant factor in these findings.

Colvert et al. 2008 used both the Strange Stories to assess ToM and the Stroop task to assess EF in a group of 165 Romanian adoptees, of these 144 were adopted into the UK from deprived institutional settings before 43 months old, and a group of 52 within-UK adoptees, all adopted before they were 6months old. Both groups were tested at 11years old. The Romanian adoptees displayed deficits in both ToM and EF compared with the within-UK adoptee group. The degree of deficit was greater for children who had experienced more than 6 months of institutional deprivation. Deficits in both domains (ToM and EF) were associated with each of the three apparently deprivation-specific problems, namely quasi-autism, disinhibited attachment and inattention/overactivity. Statistical analyses indicated a mediating role for both ToM and EF with respect to quasi-autism; a partial mediating role for EF with respect to inattention/over activity; and no mediating role for either ToM or EF in disinhibited attachment behaviours.

Similarly, when focusing specifically on DSED, Kay and Green (2016) found that children living in out of home care in the UK demonstrated a hostile attribution bias and poor ToM abilities as measured by the Strange Stories, but this was confounded by language ability. ToM was associated with reduced hostile attribution and responding biases and increased social competence, which was further associated with lower levels of externalizing psychopathology. This research found no clear evidence for an association between social cognition and the key features of DSED, suggesting that social cognitive deficits play a role in externalizing psychopathology and relationship difficulties in children (such as forming meaningful reciprocal relationships in those who have been maltreated), but these may not be directly related to DSED behaviours. They suggest that ToM and other social problem-solving skills may still be useful for intervention in this group.

Moving away from social cognition and focusing on EF in DSED, Bruce et al. (2009) compared children who had been adopted internationally from institutional care to those who had been adopted internally from foster care, and children who were raised by their biological parents. It was found that both groups of adopted children displayed more disinhibited behaviour than those who were brought up by their biological families. They also found that disinhibited social behaviour was not significantly correlated with general cognitive ability, attachment behaviours or basic emotional abilities, but was negatively associated with inhibitory control even after controlling for the amount of time the children spent in institutional care. This suggests that DSE may be due to fundamental deficits in inhibitory control.

Similarly, recent research by Gorter et al. (2017) supports these findings, from a 4-wave longitudinal research study that rejects the argument of attachment related issues being the cause of DSED and found evidence from structural equation modeling to suggest that early deprivation and DSED was mediated by general issues with inhibitory control and not by attachment.

The evidence from the current literature suggests that whereas attachment to a consistent caregiver can be discounted, it is possible that DSE and/or being maltreated is related in some way to issues with ToM and/or EF, particularly inhibitory control. It also highlights that there is a need for more research on DSE and related factors. As children who display signs of IF tend to have equally poor social understanding as those with ASD, similar research attention is warranted.

1.8: The Present research

Thus, based on the above literature review I propose that computer role-play technologies, as opposed to traditional 'paper and pencil' measures, can offer a valuable method for measuring social behaviours in clinical settings and controlled research environments, that can provide a 'more real-life' assessment of children's social behaviour. The present study will bring together knowledge from research in psychology, child psychiatry and computer sciences, but the research method will take an experimental psychology approach. This approach fills a gap in the literature as previous research investigating IF has taken a largely qualitative and/or medical approach (e.g. Bennett et al. 2009; Lawler et al., 2014; Minnis et al., 2007; Minnis et al., 2002).

The key aims are:

- To create a new method for quickly identifying IF/ DSE and social vulnerability in middle childhood.
- To investigate/highlight the potential benefits of computer role-play technologies as psychological measurement tools for assessing children's social behaviour in a more ecologically valid way.
- To gain knowledge of primary school aged children & looked after accommodated children's social cognitive style and executive functioning.
- The findings will aim to disentangle which is the strongest psychological predictor of social vulnerability; social cognition or executive functioning.

- This knowledge can be used to make recommendations for intervention e.g. should interventions have a cognitive or social focus?

Research Questions:

- **Study 1:** Will there be a difference in performance between the paper and pencil vignettes and computer mediated role-play scenarios?
- **Study 2:** What best predicts IF: inhibitory control, cognitive flexibility or theory of mind?
- **Study 3:** Do LA children have poorer IF in the computer mediated role-play scenarios than LR children?
- **Study 4:** What best predicts IF: Affective decision making, cognitive flexibility or social cognition?
- **Study 5:** Does improving the technology of the computer mediated role-play scenarios change the children's performance or increase usability and enjoyability?

Chapter 2: Summary of aims for each empirical chapter

2.1: Study 1: "Paper and Pencil" versus Computer mediated role-play and the relationship with ToM

Traditionally a successful way to measure children's social understanding has been through the use of story vignettes, for example Happè's (1994) 'Strange Stories'. A wealth of more recent research has demonstrated the value of utilising computer mediated role-play to assess children's behaviours (Aylett et al., 2005; Jones et al., 1998; Kokina & Kerin 2010; Minnis et al., 2010; Rajendran & Mitchel 2000; Rajendran et al., 2005). For example, Rajendran and colleagues (Rajendran & Mitchell, 2000; Rajendran, et al., 2005) argued that such tasks (verbal or nonverbal) measure children's *reflective* rather than *working* understanding and that computer role-play offers a truer indication of children's understanding. In this research the authors employed a computer mediated role-play measure of ToM which were largely based on Happé's (1994) 'strange stories' vignettes. The research was carried out on adolescents with an ASD diagnosis. Despite this group having difficulties with the original strange stories and general difficulties with role-playing or social interactions, the participants in this study took to the computer mediated role-play well and seemed to enjoy this form of interaction.

At the same time, it is argued that children's social thought is related to their real-world behaviours (e.g. Huges and Leekam 2004). There is a wealth of research exploring social skills and ToM in those with ASD, but little research which focuses on other socially vulnerable groups of children. For example, IF is a behaviour commonly displayed in children who are in care or who have been institutionalised. At present there are limited ways to measure IF/DSE in middle childhood. Most clinicians and researchers employing interview techniques or parent/ teacher reports (e.g. Bennet et al., 2009 Kay and Green 2016; Millward et al., 2000, Minnis et al., 2002, & Minnis et al., 2007). This study aims to fill this 'gap' in the literature by creating two versions of an IF/DSE measure which directly captures the children's behaviours. One will be story vignettes and the other computer mediated role-play scenarios.

Before, the measures created can be utilised in an atypical population it is important to establish developmental norms. Children were asked to comprehend vignettes and role-play various characters in a variety of scenarios to investigate their disinhibited social behaviour/ social vulnerability.

Objectives:

- To create a series of stories based on DSM criteria that would be used for studying disinhibited social engagement in children.
- To use these stories in both 'paper and pencil' and computer role-play formats and contrast children's performance on both formats;
- To look for associations between performance on these measures (in both formats) and on theory of mind performance.

Hypotheses:

- Children will demonstrate more IF/DSE behaviours in the computer mediated role-play task in comparison to their answers to the story vignettes.
- There will be developmental age differences in performance with 10-year-olds demonstrating less IF behaviours than 8 or 6-year-olds.
- There will be a negative relationship between performance on the IF measures and performance on the 'strange stories'.
- There will be a positive relationship with parent and teacher reports on the RPQ and the children's performance on the IF/DSE measures.

2.2: Study 2: What best predicts IF: inhibitory control, cognitive flexibility or theory of mind?

At present there is a strong focus on research which teases apart individual EFs looking at the neural- correlates and as being a higher level of cognitive processing (Barkley 1997; Craig et al., 2016; Gioia, et al., 2010; Gioia, et al., 2010; Happé et al., 2006; Schmitz et al., 2006). Historically EF has a long tradition in psychology in explaining the intertwined nature of cognition and social interaction. The Vygotsky-Lurian tradition placed importance on the role of social processes in executive control and attention skills (Carlson, 2009). Vygotsky (1978) believed that the development of EF came out of social interactions. Here, social interaction is the mechanism for the diffusion of the cultural tools of language and related symbol systems that are involved in the ability of executive control. There is much empirical research evidence demonstrating a relationship between social understanding and executive functioning Carlson, 2009; Carlson et al., 2004; Lewis and Carpendale 2009 & Perner et al., 2002), however, the evidence is largely correlational and not predictive.

This study aims to extend and add to previous research by exploring if EF is a predictive factor of IF/DSE and social vulnerability

Objectives:

- To improve on the role-play-game from the previous chapter.
- To disentangle which is the strongest psychological predictor of social disinhibition (or social vulnerability); social cognition or executive functioning namely: inhibitory control or cognitive flexibility.
- To look at the development of IF/DSE behaviours between 6 and 8-year-olds using computer-mediated role-play.
- The research will help inform intervention strategies, i.e. should intervention be more focused on improving general cognition (i.e. inhibition & cognitive flexibility) or specific social aspects (i.e. ToM).

Hypotheses:

- It is expected that ToM, inhibition and cognitive flexibility will be predicative factors of IF/DSE performance in the computer mediated role-play scenarios.
- It is expected that age will be a predictive factor of IF/DSE performance in the computer mediated role-play scenarios.

2.3: Study 3: Investigating IF using computer mediated role- play in Looked after children: The role of Inhibition and Theory of mind

The study intends to establish the developmental differences of looked after children (LAC) in comparison to age and gender matched low risk controls (LRC).

The potential advantages of computer-mediated role-play tasks as measures of DSE in middle childhood with be explored, to compliment other research focusing on DSE (Lawler et al., 2014; Bruce et al., 2009). As well as being more socially disinhibited, research demonstrates that children in foster care suffer from poorer theory of mind and executive function (Pears & Fisher, 2005; Kay & Green 2016), and in particular inhibitory control may be an issue (Bruce et al., 2009).

This research will extend the work of Pears and Fisher (2005) and Kay and Green (2016) whose findings demonstrated that being in foster care was significantly related to poorer theory of mind capacities, although both studies are of very high quality, the present research will address some of the limitations.

For example, I will demonstrate how the theory of mind deficits in looked after accommodated children are related to 'real world' social vulnerabilities and will also

create a statistical model which can demonstrate whether these social vulnerabilities are most related to the child's social cognitive style (ToM) or inhibitory control.

Objectives

- To gain knowledge of looked after accommodated children's social cognitive style and inhibitory control (this is currently under researched).
- To use this knowledge to disentangle which is the strongest psychological association of social vulnerability/disinhibited social engagement; social cognition or executive functioning i.e. (inhibition).
- The research will help inform intervention strategies, i.e. should intervention be more focused on improving general cognition (i.e. inhibition) or specific social aspects.

Hypotheses

- There will be a negative relationship between how the children perform on the computer role-play scenarios (measure of DSE/IF) with: Strange Stories (ToM)Executive Functioning (Inhibition: Stroop, Go/No-Go tasks).
- There will be a positive relationship between how the children perform on the computer role-play scenarios (measure of DSE/IF) with the RPQ's.
- There will be group differences in performance with LAC's performance being poorer on computer role-play scenarios measuring IF, Strange Stories (ToM), RPQ scores and inhibitory control measures (Stroop Go/No-Go) than LRC.

2.4: Study 4: What best predicts IF and Social Vulnerability using computer mediated role-play: emotional decision making or social cognition?

The previous empirical chapters reveal a strong relationship between ToM and the children's IF scores in the computer mediated role-play scenarios and chapter 4 confirmed that ToM was a predictive factor. It is widely accepted that children with superior ToM abilities tend to be most socially competent in reciprocal interactions and vice versa. This chapter aims to explore other aspects of social cognition in more detail. The Social Responsiveness Scale (SRS: Constantino & Gruber, 2005) was developed to measure impairments in reciprocal social behaviours. The SRS is a 65-item questionnaire completed by parent or teacher. This measure has been previously validated in an intervention which measured children with ASDs competencies at understanding social stories (Marshall et al., 2016).

There was little evidence of inhibitory control being a predictive factor in the previous studies of this thesis. Some previous research argues that ToM can be regarded as Hot EF e.g. affective decision making or delayed gratification Carlson, Zayas & Guthormsen 2009; Zelazo & Carlson 2012) Due to the evidence in this thesis that suggest that ToM in a predictive factor of IF/DSE and social vulnerability as measure by the computer mediated role-play scenarios, it seems appropriate to explore hot EF. This will be measureing the Hungry Donkey Task (HDT) a measure of affective decision making (Crone, Bunge, Latenstein, & van der Molen, 2005; Crone & van der Molen, 2004).

Objectives:

- To explore other aspects of social cognition.
- To disentangle which is the strongest psychological predictor social cognition or executive functioning namely: Cognitive flexibility and emotional decision making.
- The research will help inform intervention strategies, i.e. should intervention be more focused on improving general cognition (cognitive flexibility and emotional decision making) or specific social aspects.

Hypothesis:

It is expected that social behaviours, social cognition and emotional decision making will be predictive factors of IF/DSE performance in the computer mediated role-play scenarios.

2.5: Study 5: The creation of a bespoke serious game for the scenarios: A pilot study

In collaboration with a PhD student of computer sciences a bespoke version of the computer role-play scenarios was created. This will be experimentally compared with the version used in previous empirical chapters and evaluated by both myself and the child participants. The aim of this research study is to determine if there is a quantitative difference in the children's performance across the two task modes. The advantages and disadvantages of the software programs will also be investigated from both the children's perspective and from a research perspective. This will be in the form of descriptive responses from the children, on what they liked and did not like about each software programs, and the advantages and disadvantages of my experience of using the software for research purposes. It is expected that this information will be useful for future research collaborations between psychologists and computer scientists who wish to improve on the software used in this thesis.

Objectives:

- To create bespoke versions of the computer-mediated role-play scenarios, that address the limitations of the software utilised in chapters 3-5.
- To investigate/highlight the potential benefits of computer role-play technologies as psychological measurement tools for assessing children's social behaviour.
- To evaluate the advantages and disadvantages computer mediate role-play measures created in this thesis from both my perspective as the researcher, and the child participants perspective.

Table 2.1: Summary of Empirical Work

	Research Questions	N of Child Participants	Variables	Measures
Study 1 (Chapter 3)	Will there be a difference in performance between the Paper and Pencil Vignettes and Computer Mediated Role-Play Scenarios?	54	• Indiscriminate Friendliness (IF) x 2 task presentations and questionnaires • Age: 6 years old • 8 years old and 10 Years old • Theory of Mind (ToM)	• 11 "Paper Pencil" Vignettes measuring IF. • 11 Computer mediated role-play (Kar2ouche) scenarios measuring IF. • 'Strange Stories' measuring ToM • Teacher and Parent versions of the Relationship Problems Questionnaire (measures IF)
Study 2 (Chapter 4)	What best predicts IF: inhibitory control, cognitive flexibility or theory of mind?	70	• Indiscriminate Friendliness • Inhibitory Control • Cognitive flexibility • ToM	• 12 Computer mediated role-play (Kar2ouche) scenarios measuring IF. • Classic Stroop Test and Go/NoGo measuring inhibitory control • Dimension Change Card Sort (Cognitive flexibility). • 'Strange Stories' measuring ToM
Study 3 (Chapter 5)	Do LA children have poorer IF in the computer mediated role-play scenarios than LR children?	25	• Indiscriminate Friendliness • Inhibitory Control • ToM	• 12 Computer mediated role-play (Kar2ouche) scenarios measuring IF. • Classic Stroop Test and Go/NoGo measuring inhibitory control. • 'Strange Stories' measuring ToM
Study 4 (Chapter 6)	What best predicts IF: Affective decision making, cognitive flexibility or social cognition?	53	• Indiscriminate Friendliness • Cognitive flexibly • General Social Cognition • Affective Decision Making	• 12 Computer mediated role-play (Kar2ouche) scenarios measuring IF • Dimension Change Card Sort (Cognitive flexibility) • Teacher ratings on Social Responsiveness Questionnaire 2 • Hungry Donkey Task
Study 5 (Chapter 7)	Does improving the technology of the computer mediated role-play scenarios change the children's performance or increase usability and enjoyability?	10	• Indiscriminate Friendliness (IF) x 2 task presentations	• Computer mediated role-play (Kar2ouche) scenarios measuring IF • Computer mediated role-play (JavaScript) scenarios measuring IF • Children's indicative responses

Chapter 3: Study 1: "Paper and Pencil" versus Computer mediated role-play and the relationship with Theory of Mind

A version of this chapter is published in *Computers and Education* (See Appendix 5).

3.1: Introduction

3.1.1: ToM and Social Behaviour

Early ToM research focused on age-related changes to children's conceptualisation of ToM with the majority of research establishing that in typically developing children ToM understanding improves with age with ToM being poor at 3 years old, then significant gains in understanding of more complex mentalising concepts are made throughout the primary school years (Happè 1994 Carpendale & Chandler 1996; Chandler, Sokol & Hallett, 2001; Harris, Johnson, Hutton, Andrews & Cooke, 1989).

For example, children's understanding of mental representations continues to improve beyond 4 years old. Later advances include understanding (i) erroneous beliefs about beliefs (Perner & Wimmer, 1985); (ii) the role of pre-existing biases and personal taste preferences (Carpendale & Chandler, 1996) and how people interpret ambiguities (Pillow & Henrichon, 1996) or moral dilemmas (Chandler et al., 2001); (iii) indirect forms of social deception such as bluffs and white lies (Happé, 1994); (iv) unclear or mixed emotions (Harris et al., 1989).

It is now well established that there are links between children's social thought and their social behaviours. Indeed, ToM research has been critical in gaining this understanding of the social world from the child's perspective. The aim of the research in this area is to evidence that ToM underlies the ability to attribute mental states to other individuals in order to make sense of the social world. There is not much recent research focus on this area, over the last 30 years or so research has provided many environmental reasons for individual differences (Bosaki & Astington 1999; Olson, Lopez-Duran, Lunkenheimer, Chang & Sameroff 2011; Sutton, Smith & Swettenham 1999) and the real-life consequences of ToM development in children (Astington, 2001).

For example, Bosaki and Astington (1999) investigated the link between the ability to interpret ambiguous social circumstances and to interact successfully with peers. They found associations between ToM ability and peer ratings of the children's

social interaction skills. Whereas, other research has found that superior Tom abilities in some children may have a negative impact such as research that demonstrates the 'ring leader' in school bullying situations tends to have a good ToM understanding (Sutton et al., 1999). Also, research has linked ToM abilities to peer aggression (Onslo et al., 20011). It also appears that in the real-world children can use their ToM ability to win more friends but superior understanding of another's mental state can lead to emotional issues in some instances, thus, it is important we continue to explore other real-world consequences (Astington, 2001; Wellman, 2018).

3.1.2: Measuring ToM

As discussed in the general introduction, measuring ToM has gone from using various formats of the false belief tasks e.g. characters/dolls such as 'Maxi' and his chocolate bar in the unexpected transfer test (Wimmer & Perner, 1983). This task was updated in the Sally Anne Test (Baron-Cohen, et al., 1985). In this task after the researcher introduces the dolls, the child is asked the control question of recalling the names of the dolls. Once the child passes this question the typical false belief task paradigm is played out: Sally takes a ball and hides it in her bag. She then "leaves" the room. While she is away, Anne takes the ball out of Sally's bag and puts it in her own basket. Sally then comes back, and the child participant is asked: "Where will Sally look for her ball?" To pass the child must answer the question correctly by stating that Sally will look for the ball in her own bag.

It has been demonstrated that the majority of typically developing children can pass this test by around 5/6 years old, but children with ASD are poorer at this (Baron-Cohen, et al., 1985).

Despite their success, these tests have been criticised for many reasons. For example, it has been highlighted that they only test one aspect of the complex social cognitive process underlying ToM, such as sarcasm and white lies. This means that although it is a robust test, it does not measure other aspects of ToM (Lewis & Carpendale 2006).

Nevertheless, Happé's 'Strange Stories' are simplified narratives of everyday scenarios followed by questions that assess the participants understanding of nonliteral language short stories (included measures of sarcasm, figures of speech, white lies, etc.). Versions of these stories have been shown to discriminate developmental stages (O'Hare et al., 2009), between those who do and do not have ASD (Happé 1994) and DAD (Kay

& Green, 2016). Even those who passed 2nd order ToM tasks gave incorrect responses to some of the strange stories (Happé 1994; Jolliffe & Baron-Cohen 1999).

Despite the popularity of story vignettes, it is argued that most of the experimental paradigms designed to assess ToM abilities involve fairly well developed expressive and receptive language skills, which can cause issues, because many groups of children have poor verbal abilities (Colle et al., 2007). Thus, failure on such tasks may in fact reflect participants' inability to comprehend task instructions, nearly as much as deficits in mental-state understanding (Frye et al. 1995; Astington 2001). As such other novel approaches have been suggested, for example; Sivaratnam, Cornish, Gray, Howlin and Rinehart (2012) successfully validated a colourful comic strip ToM measurement tool that better relies on non-verbal abilities to facilitate children who suffer from language related impairments. The success of this type of task relies on clear visuals such as the characters changing emotions and changing scenes presented in each scenario to help the children follow the story with ease in a non-verbal way.

Despite this Rajendran and colleagues (Rajendran & Mitchell, 2000; Rajendran, et al., 2005) argued that such tasks (verbal or nonverbal) measure children's *reflective* rather than *working* understanding and that computer role-play offers a truer indication of children's understanding. In this research the authors employed a computer mediated role-play measure of ToM which were largely based on Happé's (1994) 'strange stories' vignettes. The research was carried out on adolescents with an ASD diagnosis. Despite this group having difficulties with the original strange stories and general difficulties with role-playing or social interactions, the participants in this study took to the computer mediated role-play well and seemed to enjoy this form of interaction. These findings suggest that not all those with ASD had difficulties with correctly communicating in this format in comparison to using the "paper pencil" vignettes.

Thus, computer role-play offers the chance of using more of a simulation theory approach to ToM. This line of thought comes from the work of Johnson (1988) and Harris (1993) who argued that the individual's capability to explain and predict the behaviour of others involves "mental simulation" where during middle childhood the child gradually develops the ability to imagine hypothetical circumstances, even those that may be at odds with reality e.g. false belief. In other words, putting 'oneself in another's shoes' and potentially having to mentally simulate what a character is thinking or might do in a hypothetical situation (Harris, 1992; Jones et al., 1998). This is in contrast with the story vignette paradigm in which a child might feel under pressure to give the correct or most

appropriate answer (Seigal, 2004) or have to work the correct answer in a more abstract or 'theory theory' type way (e.g. Perner 1988, 1991; Chapman, 1988).

This theory posits that meta representation develops gradually throughout the early childhood years. Firstly, the child learns through symbolic play by using objects in unconventional ways (e.g. using a cardboard box as a car). Meta-representation is the ability to construct a model of the relationship between a representation and what it signifies. This skill allows us to understand misrepresentation (that beliefs can be wrong) and hypothetical situations, through planning a set of strategies and working out which is best. This means that the 'theory theory' approach requires a multifaceted procedure of hypothesised mental recursions to understand second order false beliefs.

Despite this being the most widely accept theoretical argument for how children mentalise. Harris's (1993), work suggests that this approach is too complex for children. Instead, imagining themselves in the situation of another that is different from their own is less complicated than expecting that children construct multiple hypotheses about another's thoughts. It should, however, be noted that both simulation and 'theory theory' approaches are not entirely incompatible and can be accepted together (Wellman 1990). In this sense I believe it is possible that later in development (e.g. later in the primary school years) these mechanisms begin to work together.

3.1.3: Measuring IF/DSE

As explained in the general introduction IF/DSE has been measured in a number of ways. Currently, our knowledge on children disinhibited social behaviour is largely derived from observational and qualitative research (Bennett et al., 2009; Bruce et al.,2009; Lawler, et al., 2014). This research generally focuses on DSE in infants and adolescents because measuring this level of social behaviour accurately in middle childhood has proved challenging for both clinicians and researchers (Minnis et al., 2010).

Millward et al. (2006), Minnis et al. (2002), & Minnis et al. (2007) assessed RDA & DSE behaviours using the relationships problems questionnaire, which is a parent and teacher checklist that includes items that measure DSE/IF. Despite this measures success, it does not allow the clinician or the researcher to capture or witness the child's actual behaviours in real situations. Thus, there is much need for measures that focus on the 'real world' DSE/IF behaviours in middle childhood. As well as measuring DSE/IF, I argue that for a typical population of children, my computer role-play task is a valid measure of

social vulnerability, therefore, I aim to employ the RPQ's as an additional method of validating the role-play scenarios.

3.1.4: The present Study

Here, I aimed to investigate a) age-related developmental differences in DSE in middle childhood and b) potential differences of computer-mediated role-play tasks as measures of DSE over a "paper pencil" tasks. I also investigated the relationship between DSE, Theory of Mind (ToM), and parent and teacher ratings of the child's quality of relationship (RPQ). Children were, therefore, asked to comprehend vignettes and role-play various characters in a variety of scenarios to investigate their DSE.

Hypotheses:

- Children will demonstrate more IF/DSE behaviours in the computer mediated role-play task in comparison to their answers to the story vignettes.
- There will be developmental age differences in performance with 10-year-olds demonstrating less IF behaviours than 8 or 6-year-olds.
- There will be a negative relationship between performance on the IF measures and performance on the 'strange stories' (ToM).
- There will be a positive relationship with parent and teacher reports on the RPQ and the children's performance on the IF/DSE measures.

3.2: Method

3.2.1: Participants & Design

Table 3.1: Participant Characteristics

Age Groups	**N**	**Gender**	**14 -TRPQ Mean (SD) Max Score = 42**	**10-PRPQ Mean (SD) Max Score = 30**
6	16	M8, F8	2.96 (2.10)	.94 (.37)
8	17	M8, F9	1.59 (1.80)	0.65 (.93)
10	20	M9, F11	0.90 (1.29)	0.20 (.52)

A total of 54 children were recruited to this study: 3 groups of typically developing children aged 6, 8, & 10 (see Table 3.1). One participant from the 10-year-old group was removed due to her score on the computer mediated-Role-play task being much higher than the mean score for this age group. I used a 3 × 2 factorial design: with a between subject's factor of age and a within subject's factor of presentation ('paper and pencil vignette' vs. 'computer role-play' version of the DSE task).

3.2.2: Materials & Procedure

The first stage of recruitment involved a formal approach to Local Education Authorities (LEA) in Scotland who were contacted in writing to request permission to undertake research in schools. After permission had been granted, permission was sought and granted via letters to Head Teachers from the LEA, and schools were chosen on an opportunistic basis.

Following ethical and LEA approval and the granting of Head Teacher and parent/guardian permission, I obtained a list of the pupils whose parents/guardians had consented to their child's participation from each of the 3 schools. Children were tested individually in a quiet room within their school. This allowed children to provide informed assent and complete the tasks under controlled experimental conditions.

The permission of parents/guardians was requested and obtained in writing via information sheets and consent forms distributed and collated by schools. Children (who verbally assented to take part on the day of testing) then completed all tasks during a single school day. Inclusion criteria were being of primary school age (between the ages of 6 and 9 years). I introduced myself to the participants, explained the purpose of the study and what the tasks would involve. Children were told that their Head Teacher and parent/guardian had consented to their participation, but it was made clear to the children that it was their decision whether or not they wanted to take part and they could drop out an any point without an explanation needed. This was important given the length of the testing session. After this had been explained children were asked for their assent to take part.

If this was granted I explained each of the tasks participants would go on to complete. Participants were also invited to take short breaks between tasks as necessary. Each task was explained to participants in terms of its aim and operation before participants began trials. Instruction about the operation of each task was provided verbally in language that the children could understand and at the beginning of each task

participants were made aware of the nature and purpose of practice trails. Following practice trials participants were able to ask any questions they wished to before formally beginning each task. Following completion of the final task, participants were thanked for their participation by the researcher and given the opportunity to ask any additional questions they had about the study and its aims. Often children asked for feedback on their performance. In these instances, I explained that there were no right or wrong answers and that the aim of the study was to establish what children of different ages thought was the best way to respond as a whole, rather than individual performance.

Computer Mediated Role-Play and Story Vignette Validation

The computer mediated role-play scenarios and story vignettes were independently validated by Professor Helen Minnis and colleague, who are experts in the field of child reactive attachment disorder and Disinhibited Social Engagement Disorder using a 5-point rating system (Strongly agree to Strongly Disagree) on each of the disinhibited social engagement disorder symptoms (DSM-V 2013: see appendix 1). It was agreed that every story tapped into one or more of the specific symptoms of DSE (See Appendix 2). Both paper pencil and computer versions of the DSE tasks are matched on themes and scoring to make them comparable. These tasks were counterbalanced across participants. The order of scenarios and vignettes were pseudo-randomised across participants.

Relationship Problems Questionnaire

The 14 item Teacher Relationship Problems Questionnaire (TRPQ) and 10- item Parent Relationships Problems Questionnaire (PRPQ: e.g. Minnis et al., 2007; Millward et al., 2006) and the already well-established Strange Stories ToM vignettes (O'Hare 2009) were employed. The 10-item PRPQ was sent to parents to be completed along with the consent form, these were then returned to the child's school. The child participants took part in 3 × tasks: 1 = Paper pencil ToM vignettes (Strange Stories: O'Hare 2009), 2 = Paper pencil DSE vignettes, (appendix 2: Please contact first author for complete materials) 3 = Computer role-play measure of DSE in a children's computer story boarding called Kar2ouche (see appendix 4). The class teachers completed the 14 –item Teacher RPQ on each child who took part in the study. The RPQ's are a measure of children's social behaviour's that relate to the themes of Disinhibited Social Engagement Disorder and have been validated on both atypical and typical populations of children (e.g. Minnis et al., 2007).

The children worked along with the researcher individually in a quiet room at their school. Testing time was approximately 1 hour per child and short breaks were granted at the child's leisure.

3.2.3: Scoring Procedures

'Strange Stories'

12 strange stories accompanied by pictures were read out. Two questions per story were asked, the first requiring a 'yes or no' comprehension answer and the second requiring an open-ended justification answer. The procedure and scoring are in accordance with O'Hare et al., 2009.

Paper Pencil Vignettes

11 different vignettes were used (appendix 3). Comprehension questions were rated as correct (1) or incorrect (0). Responses to the justification questions require more subjective judgements on the part of the scorer. One point was awarded for each response that indicated that the child was engaged in behaviours which could lead them to be socially vulnerable, these behaviours were judged on the criteria from the DSM-V for each of the themes being investigated. A score of zero was give when the child's response indicated correct justification of the question. Thus, the scoring of each vignette was between 0-2. Two raters coded the responses; the first rater was the primary researcher during the testing phase and coded all the data. The second rater was naive to the aims of the study and blind to participants' group membership; they coded 20% of the data. Any inconsistencies or confusion over answers/scores were resolved through discussion between the raters after the initial blind rating took place; inter-rater reliability (r = .82).

Computer-Mediated Role-play Scenarios

11 different computer-Mediated role-play scenarios were used (appendix 4). These scenarios were created in an interactive children story boarding software called Kar2ouche by Immersive Education a joint project between Oxford university and intel. This software was released in 2001. Like the Story vignettes, comprehension questions where the child responded with a yes or no were rated as correct (1) or incorrect (0). Responses to the justification questions require more subjective judgements on the part of the scorer. One point was awarded for each response that indicated that the child was engaged in behaviours which could lead them to be vulnerable; these behaviours were

judged on the criteria from the DSM-V for each of the themes being investigated. A score of zero was given when the child's response indicated correct justification/awareness of the safest actions to be taken. So, the scoring of each vignette was between 0-2. Two raters coded the responses; the first rater was the primary researcher during the testing phase and coded all the data. The second rater has a degree in psychology but was naive to the aims of the study and blind to participants' group membership; they coded 20% of the data. Any inconsistencies or confusion over answers/scores were resolved through discussion between the raters after the initial blind rating took place; inter-rater reliability: [r = .99].

3.3: Statistical Analysis

One repeated measures 3 × 2 factorial ANOVA: with a between subject's factor of age and a within subject's factor of presentation ('paper and pencil vignette' vs. 'computer role-play' version of the DSE task). Additionally, the 14 TRPQ and 10- item PRPQ: were correlated using Pearson's correlations with the Strange Stories (O'Hare 2009). All analysis was carried out using IBM SPSS statistics 22.

3.4: Results

There was a significant main effect of task presentation (computer mediated role-play, paper pencil) [F (1, 47) = 34.66, $p < 0.001$ Cohen's $f = 0.86$] *Post hoc* tests revealed that 6-year-olds displayed more DSE than 8-year-old s [$p < 0.001$] and 10-year-olds [$p < 0.001$]. There was no significant difference between 10 & 8-year-olds, [$p = .287$]. There was a significant interaction between task presentation (Computer Mediated Role-play, Paper Pencil) and the age group of participants [F (2, 47) = 3.27, $p = .047$ Cohen's $f = 0.37$]. *Simple effects analysis* revealed that 6-year-olds [$p< 0.001$] and 8-year-olds [p=.002] displayed significantly more DSE in the computer mediated role-play task, than in the paper pencil vignettes, whereas 10-year-olds DSE did not significantly differ between task presentation [p =.081]. See Figure 1.4.

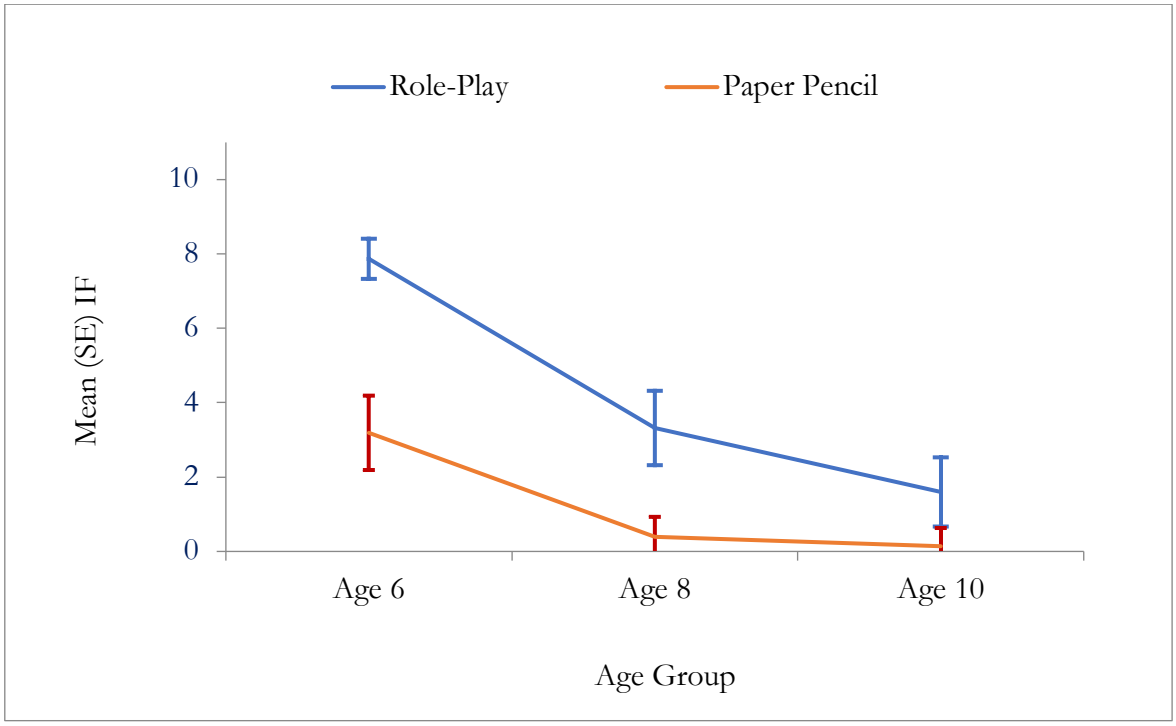


Figure 1.4: Mean (SE) IF by task presentation (role-play & paper pencil) and age group.

Theory of Mind was negatively correlated to both DSE tasks with a Pearson correlation coefficient of [r = -.439] and a significance value of [$p < 0.001$] for the paper pencil task and Pearson correlation coefficient of [r = -.379] and [p = 0.003] for the computer mediated role-play task.

No correlations were found for the RPQs and DSE in either task presentation (paper pencil, computer mediated role-play). This is probably because the RPQ is a clinical measure and typically developing children were recruited in this study.

3.5: Discussion

First, my results show IF/DSE behaviours seems to be developmental, i.e. 10 and 8-year-old showing fewer disinhibited behaviours than 6-year olds. Second this age differentiation was greater in the computer mediated role-play version of the task. So, these findings support my hypothesis that children will exhibit more DSE behaviours in the computer role-play than the paper pencil version of the task. Third, my prediction that there would be a negative relationship between DSE and ToM was also supported which is particularly important to validating the measure. This finding progresses the field of

ToM development to a new potential 'real-world' consequence of ToM development to the area of social vulnerability.

This study was also the first to successfully quantify DSE and social vulnerability in middle childhood and is, also, the first to investigate the development of DSE and social vulnerability in the typical population of children. Further, I demonstrate the value of computer-mediated role-play, which extends serious gaming's current sphere of research activity into the field of children's psycho-social measurement.

My findings support previous research that suggests using role-play measures children's working understanding in comparison to vignettes that rely on a more reflective understanding (Rajendran & Mitchell, 2000; Rajendran, Mitchell & Richards, 2015).

The findings also support previous research which links ToM to aspects of social understanding (Astington 2001; Caependale & Lewis 2006: Huges& Leekam 2004: Jenkins & Astington 2000; Wimmer and Perner 1983; Wellman 2018). Arguably the younger children performed in a way that is closer to their real-life behaviours in the role-play task because this allowed the child to simulate or "walk in the shoes" of the character and make real decisions in a simulation type way (e.g. Harris, 1992). Rather than deciding on what the characters might do in a hypothetical situation that is created using social vignettes where a child might feel under pressure to give the correct or most appropriate answer (Seigal, 2004), or have to work the correct answer out in more abstract or 'theory theory' type way (e.g. Chapman, 1988). This method seems to be especially valuable for children in the middle childhood range of around age 5 – 9 years old, whereas there was no significant difference in the scores of paper-pencil and role-play task version for the older children. This may because by the end of middle childhood/primary school years, typically developing children have largely mastered basic awareness of social safety.

Thus, from a theoretical perspective, the findings support a simulation theory account of the development of ToM in middle childhood (Harris, 1992). This is important because it suggests that children's "real-world" behaviour is more likely to be measured accurately from a first person (e.g. role-play), rather than a third person (Paper pencil) perspective. This finding also arguably supports the concept of presence (e.g. Slater 1997), in which responses in the computer role-play task version are more like the responses that participants might give in real life.

An explanation for this may be that higher levels of disinhibited behaviour in a computer role-play task were due to the perceived safety of the environment. I argue

though that this is unlikely because I recruited only typically developing children and found that most participants in the youngest age group (6-year-olds) achieved approximately only a quarter of the potential total disinhibited score available. This means that disinhibited and vulnerable behaviours are relatively low (as to be expected in this population), so there is plenty of "room" in the assessment to measure atypical behaviour. In order to fully validate this measure, therefore, it is important that future studies look at the differentiation of typical and atypical DSE and social vulnerability in middle childhood.

Indeed, such future research would add to the validation of this psychological measurement and has the potential to be of use in research related to attachment and disinhibited social engagement disorder, which up until now has been largely observational and qualitative in nature (e.g. Bennet et al., 2009). Children with attachment related disorders tend to display signs of social vulnerability, which in part along with cognitive and environmental factors is thought to be related to having a poor theory of mind (Pearce & Fisher, 2005; Kay & Green; 2016). My findings demonstrated that poor theory of mind was related to higher levels of DSE or social vulnerability and (vice versa; good theory of mind is related to better social safety understanding no DSE).

In practical terms this means that some children can be very socially vulnerable when interacting with unfamiliar adults, as they cannot understand the intentions of others, therefore, creating a safe virtual environment that maps on to real-life settings to asses these social vulnerabilities is essential for clinicians and researchers in this field. This means the findings in the present research have implications for how technological advancement can be useful in both assessment and intervention in research, clinical practice and education. This will be discussed further in the general discussion of this thesis.

Chapter 4: Study 2: What best predicts IF: inhibitory control, cognitive flexibility or theory of mind?

4.1: Introduction

The conclusions of the empirical research in the previous chapter demonstrated a socially dominant understanding of indiscriminate behaviours or social vulnerability in children, with there being a relationship between IF/DSE and ToM. They also revealed a clearer 'normal' distribution of results in the computer mediated role-play version, in comparison to the paper and pencil vignettes. The present chapter will describe the use of EF and ToM tasks as predictors of the computer mediated role-play measure of IF/ social vulnerability for further validation of this measure.

As mentioned in the general introduction of this thesis, links between social behaviour and cognitive abilities has seen a revival recently, after many decades of focus on standalone cognitive theories and on atypical development (executive dysfunction, as in ADHD and ASD), establishing psychometric norms, proposed psychological mechanisms, neural substrates, and the cognitive/academic and social predictors/correlates of individual differences in EF (Carlson, 2009). This research has contributed immensely to knowledge in the field, although, it does not acknowledge the importance of social interaction, despite a long tradition in psychology of exploring social interaction by means of investigating the development of EF (Lewis & Carpendale 2009; Carlson 2009). Nevertheless, some recent studies in this topic have suggested a link between social interaction and EF (Bock, Galloway Hund, 215). So, the development of EF may also assist in providing the cognitive skills that are important for successful social interaction (Moriguchi, 2014).

In this chapter, I report a study which explores two types of EF; inhibitory control and cognitive flexibility across 3 tasks. Importantly, beyond the nursery school years EF is not unitary; i.e. in middle childhood and beyond EF consists of many sub components such as inhibition, working memory, cognitive flexibility and problem-solving (Miyake et al., 2000; Miyake et al., 2012). Cognitive flexibility or set-shifting is the ability to change from one method of problem solving to another equally good method that may further improve the chances of success in a given task or situation (Lewis & Carpendale 2009). Thus, flexibility is important for allowing an individual to cope well with an unexpected change in circumstances. Current research has focused on the emergence of flexibility during early childhood, utilising sequential rule- switching tasks such as the dimensional change card sorting (DCCS) task. In the DCCS, children sort cards based on

one dimension (colour) then switch to a second dimension (shape). Studies have shown a clear aged-based task peformance between 3 and 5 years (Frye et al., 1995; Kirkham, Cruess, & Diamond, 2003; Towse, Redbond, Houston-Price, & Cook, 2000) For the more complex rule-switching "border" version of the task, improvements in performance continue to be made throughout middle childhood (Zelazo 2006).

As discussed in the general introduction, recent research suggests that indiscriminate behaviours may have similarities to ADHD rather than being linked to attachment related disorders. Due to the suggestion that aspects of IF and DSE may be similar to ADHD (APA, 2013) it is important to explore other aspects of EF such as inhibitory control, which is the propensity to supress a potential response. For example, in the classic marshmallow test, which tests inhibition in the form of delay of gratification, the child is told that she/he can wait for a while with one marshmallow, they will receive two when the adult researcher returns. Inhibiting the urge to eat the marshmallow before receiving the second increases by age and is more challenging for some children than others (Mischel et al., 1972).

Inhibitory control is a key deficit in children with ADHD (Barkley, 1997; Halperin et al., 1992; Bezdjian et al., 2009). Some of the most well-known experimental methods for measuring inhibitory control are the Go/No-go (E.g. Bezdjian et al., 2009) and the classic Colour Stroop (Stroop 1935), both of which have been extensively validated in child participants and atypical groups (Adams & Jarrold 2009).

4.1.1: The links between EF and social understanding

Research has shown that social cognitive style, understanding and social interaction are linked to EF (Moriguchi; 2014; Bock et al., 2015). Thus, far there has been no research which has made any direct reference to the role of EF in social vulnerability. Due to the evidence from the literature and the strong existing research evidence of links between ToM and EF (Moriguchi, 2014; Bock et al., 2015), I believe it is conceivable because the measure in the present study is related to ToM, the underlying mechanisms of social vulnerability/IF may also be rooted in EF abilities.

Growing evidence demonstrates that EF skills may have a role in facilitating the development of social interaction skills. At present the majority of the evidence in this field highlights that there is a significant correlation between measures of EF and ToM (Flynn, O'Malley, & Wood, 2004; Frye et al., 1995; Hughes, 1998; Moses, 2005; Pellicano, 2007; Perner & Lang, 2000).

It has been suggested that meta-representational understanding which underlies ToM provides the basis for the development of EF. Indeed, Kloo and Perner (2003) found that training children's ToM understanding improved performance on the DCCS and vice versa. Longitudinal data, however, suggests that EF skill at the age of 2 years-old predicts ToM abilities at 3 years-old of age, rather than the reverse, which challenges the view that ToM improves EF (Carlson et al 2004). Domain-general EF abilities help children to benefit from social experiences that promote conceptual aspects of ToM (Carlson & Moses, 2001; Moses & Tahiroglu, 2010; Sabbagh et al., 2006). The majority of the literature thus far is based on early development and does not give detailed evidence in middle childhood. A few studies do suggest that there is a strong link between EF and ToM in middle childhood and throughout the lifespan (Apperly, Samson, & Humphreys, 2009; Apperly et al., 2011). A key issue is that most of the relevant research is not predictive and has largely utilised a correlational approach (Moriguchi 2014).

Nevertheless, growing evidence supports causal accounts of EF influences on ToM (Miller, 2009), suggesting that EF is necessary, but is not exclusively adequate, for promoting ToM understanding. Aspects of EF may influence improvements in ToM during early childhood by providing skills necessary for understanding the self and others, for example, holding in mind numerous perspectives and resisting interference from one's own perspective. Indeed, Sabbagh et al. (2006) claims that domain-general EF skills enable children to be successful in interactions relying on reasoning that involves understanding another's mental state.

One of the most relevant research studies to the present research was carried out by Bock, et al., (2015). They investigated the links between EF and ToM during middle childhood. 104 7 to 12-year-olds completed tasks measuring working memory, inhibition, flexibility, theory of mind, and vocabulary, that were created to be age-appropriate. The findings revealed a significant increase with age, particularly after 7-years old. Of importance to the present research is the finding that cognitive flexibility (as measured by an altered version of the DCCS) predicted social understanding over and above the effect of age, vocabulary working memory and inhibition. The authors acknowledged that impurity of the tasks used, such as, adjusting task parameters for different aged groups within the one sample may limit these findings.

Nonetheless, if there is evidence to suggest cognitive flexibility predicts social understanding, it is conceivable that the ability to navigate social situations (which could lead to social vulnerability) successfully may be mediated by EF ability.

4.2: Aims of Present Study

Thus far in my thesis, I have established that social cognitive style (ToM) may be related to social vulnerability and IF. Based on the above literature it can be expected that inhibitory control and cognitive flexibility will be a correlate and/or predictor of social vulnerability and IF, as well as ToM. In the study reported in this chapter I aimed to disentangle which is the strongest psychological predictor of social vulnerability and IF; ToM or EF.

Hypotheses:

- It is expected that ToM, inhibition and cognitive flexibility will be predictive factors of IF/DSE performance in the computer mediated role-play scenarios.
- It is expected that age will be a predictive factor of IF/DSE performance in the computer mediated role-play scenarios.

4.3: Method

4.3.1: Participants & Design

Table 4.1: Participant Characteristics

Age Groups	**Total N**	**N Male**	**N Female**	**Mean Age in years and Months (SD)**	**WASI FSIQ**
6-7	41	14	27	6.6 (.24)	107.76 (13.22)
8-9	29	15	14	8.6 (.33)	116.07 (19.13) *p*=.05
Overall	70	29	41	7.4 (.12)	111.20 (16.33)

A total of 70 participants took part in the study reported in this chapter: 41 were female and 29 were male. A total of 41 children were 6-7 years-old and 29 were 8-9 years-old. The findings of study 1 suggested that the scenarios were not developmentally appropriate for children older than 9 years old because floor effects were most common in the 10 & 11-year-old age group. In light of this selecting children between the age of

6-9 years old should provide a better normal distribution of results. Children in both age groups were closely matched on IQ although the 8-9-year-old group had a slightly higher WASI score [t (68) 2.15, p = .05, d = .51]. Data was collected from each participant in one or two testing sessions during the school day lasting approximately 2 hours. All participants completed the same tasks and were allocated to one of 2 age groups: 6-7-year-olds and 8-9-year-olds.

4.3.2: Materials & Procedure

4.3.2.1 Recruitment

The first stage of recruitment involved a formal approach to two LEAs in Scotland which were contacted in writing to request permission to undertake research in schools.

Following ethical and LEA approval and the granting of Head Teacher and parent/guardian permission, I obtained a list of the pupils whose parents/guardians had consented to their child's participation from each of the 3 schools. Children were tested individually in a quiet room within their school. This allowed children to provide informed assent and complete the tasks under controlled experimental conditions.

The permission of parents/guardians was requested and obtained in writing via information sheets and consent forms distributed and collated by schools. Children who assented to take part on the day of testing then completed all tasks during a single school day (where possible). Inclusion criteria were being of primary school age (between the ages of 6 and 9 years). I introduced myself to the participants, explained the purpose of the study and what the tasks would involve. Children were told that their Head Teacher and parent/guardian had consented to their participation, but it was made clear to the children that it was their decision whether or not they wanted to take part and they could drop out an any point without an explanation needed. This was important given the length of the testing session.

After this had been explained children were asked for their assent to take part. If this was granted I explained each of the task's participants would go on to complete, the order of task presentation was controlled through counterbalancing and randomisation which has been described as an appropriate countermeasure to control for fatigue effects (Bradley & Daily, 1994). Participants were also invited to take short breaks between tasks as necessary. Each task was explained to participants in terms of its aim and operation before participants began trials. Instruction about the operation of each task was provided verbally in language that the children could understand at the beginning of

each task and participants were made aware of the nature and purpose of practice trials. Following practice trials participants were able to ask any questions they wished to before formally beginning each task. Following completion of the final task, participants were thanked for their participation by the researcher and given the opportunity to ask any additional questions they had about the study and its aims. Often children asked for feedback on their performance. In these instances, I explained that there were no right or wrong answers and that the aim of the study was to establish what children of different ages thought was the best way to respond as a whole, rather than individual performance.

The child participants took part in 6 × tasks: 1 = WASI, 2= Paper pencil ToM vignettes (Strange Stories: O'Hare 2009), 3 = Computer role-play measure of DSE in a children's computer story boarding called Kar2ouche, 4= DCCS 5= Go-no-Go, 6 = Classic Colour Stroop. The WASI-II was administered to all children in one session that preceded the completing of the other Tasks. Each child was invited back approximately 1 day to 1 week after to complete the rest of the tasks in one session, see Table 4.2 for details of the order by which tasks were administered to each child.

4.3.2.2 Measures

WASI (Measures IQ)

The Wechsler Abbreviated Scales of Intelligence-Second Edition (WASI-II; Wechsler 2011) was used to measure general cognitive ability and provides standardised, age-normed intelligence quotients for verbal comprehension (VCI), perceptual reasoning (PRI), and full-scale IQ (FSIQ).

The WASI-II subtests are administered in the order described below. The WASI-II has a specific start and stop point for participants of specific ages. In addition, reversal and discontinue rules direct the examiner to administer items preceding the indicated start point if an examinee is unsuccessful on a requisite number of initial consecutive items or cease subtest administration, respectively. Only the Block Design test is timed. Timing contributes to the scoring as described below.

Block Design.

Block Design assesses analysis and synthesis of visual stimuli, nonverbal concept formation, fluid intelligence, visual perception and organization, and visual-motor coordination. It consists of 13 tasks during which two-dimensional red-and-white geometric designs are presented in the Stimulus Book. Participants attempted to re-create each design using the top of the cubes. Differential start points are specified for participants aged 6 to 8 years or 9 to 90 years. The person administering provides

demonstrated examples with a relevant picture in the Stimulus Book. Each item has a time limit, and participants were awarded points for successful re-creation of the design on the first (2 points) or second (1 point) attempt for items 1 to 4, or between 4 and 7 points based upon quickness of completion for items 5 to 13. The subtest is stopped after two successive errors.

Vocabulary.

Vocabulary measures word knowledge, verbal concept formation, stock knowledge, crystallized intelligence, and degree of language development. It contains of 31 items, encompassing 3 initial picture items. Participants were required to verbally define and/or describe a word or concept that is orally presented to them by myself (9-90-year-old participants are also provided the Stimulus Book which includes each word in a written format). All participants begin with item four, and reverse back to the pictured items if necessary. Scoring for each item is done on a zero-, one-, or two-point basis according to the general scoring principles outlined in the manual. In addition, the manual outlines specific zero or one-point responses to be probed by the researcher to gain further detail or clarity. The subtest is stopped after three sequential errors.

Matrix Reasoning.

Matrix Reasoning measures fluid and visual intelligence, spatial ability, and perceptual organisation. It consists of 30 visually presented incomplete matrices viewed from the Stimulus Book. Participants were required to view each incomplete matrix and choose one item from a selection of five options at the bottom of each page that accurately completes the matrix. Each correct item gains the participant one point. There are different start points for those aged 6 to 8 years or 9 to 90 years. The subtest is finished after three consecutive errors.

Similarities.

Similarities measures verbal concept formation, crystallized intelligence, abstract reasoning, associative and categorical thinking, and verbal expression. It contains 24 items, including 3 initial picture items. Participants were required to verbally describe the relationship between two objects or concepts presented orally by the examiner. 6 to 8-year-olds begin with the three initial pictured items in which they select one pictured item from a selection of four that fits within the same semantic category (e.g., vehicles) as two sample items (e.g., a car and a truck). Nine to ninety-year-old examinees begin with the orally stated items. Scoring for items is done on a zero-, one-, or two-point basis according

to the general scoring guidance outlined in the manual. The manual also outlines specific zero or one-point responses to be queried by the examiner to gather additional detail or clarity. The subtest is stopped after three consecutive errors.

I included measures of IQ in order to consider IQ as a potential factor in children's performance on the computer-mediated role-play task, since much research evidence highlights that cognitive ability is related to performance on experimental tasks (e.g. Sheppard & Vernon 2008).

Strange Stories (Measures ToM)

12 strange stories accompanied by pictures were read out. Two questions per story were asked, the first requiring a 'yes or no' comprehension answer and the second requiring an open-ended justification answer. The procedure and scoring were in accordance with O'Hare et al., 2009.

Computer Mediated Role-play (Measure Indiscriminate Friendliness)

All computer tasks were presented on a Dell Laptop running windows 7 operating system. The computer-mediated role-play scenarios and story vignettes were independently validated by Professor Helen Minnis, (who is an expert in the field of child reactive attachment disorder and Disinhibited Social Engagement Disorder) using a 5-point rating system (Strongly agree to Strongly Disagree) on each of the disinhibited social engagement disorder symptoms (DSM-V, APA., 2013). It was agreed that every story tapped into one or more of the specific symptoms of DSE. Both paper pencil and computer versions of the DSE tasks are matched on themes and scoring to make them comparable. These tasks were counterbalanced across participants. The order of scenarios and vignettes were pseudo-randomised across participants.

Computer Mediated Role-play Scenarios:

11 different computer mediated role-play scenarios were used (appendix 4). Like the Story vignettes, comprehension questions where the child responded with a yes or no were rated as correct (1) or incorrect (0). Improvements were made to the task where 4 scenarios included 3 possible responses rather than 2 (see appendix 5). When carrying out the research in the previous chapter, I noticed that some of the children initially answered with an incorrect response (e.g. that they would like to run to the swings alone in the dark) and then after a little deliberation their response to the open-ended question was that they thought this was the wrong thing to do. I thought this extra response could highlight issues with inhibitory control in children who are socially vulnerable. In the

end, after thinking through the scenario, some children were able to clearly explain right from wrong, but in the moment when asked what they would do some children have poorer judgment, which could lead to a number of accidents in a real-world scenario as there is no second chance for deliberation in some instances. This extra response was scored in the same manner as the first response. Responses to the third justification questions require more subjective judgements on the part of the scorer. One point was awarded for each response that indicated that the child was engaged in behaviours which could lead them to be vulnerable; these behaviours were judged on the criteria from the DSM-V for each of the themes being investigated. A score of zero was give when the child's response indicated correct justification/awareness of the safest actions to be taken. So, the overall scoring of each scenario was between 0-2 and 0-3 (for new scenarios). Two raters coded the responses; I was the first coder and applied the coding procedure to all the data. The second rater was naive to the aims of the study and blind to participants' group membership; they coded 20% of the data. Any inconsistencies or confusion over answers/scores were resolved through discussion between the raters after the initial blind rating took place. Reliability: [r = .96].

Dimension Change Card Sort (DCCS: Measures Cognitive Flexibility)

I followed the methodology from Zelazo (2006). Two sorting boxes were placed within reaching distance in front of the participants with target cards fixed to each box; a blue rabbit behind the tray on the child's left and a red boat behind the tray on the child's right. I sat beside each child. Participants were told that they would be playing a sorting game and would have to sort by either by shape ("Shape Game") or colour ('Colour Game": see figure 4.1). They were instructed to use their dominant hand and to keep going even if they made an incorrect response. Participants first completed 2 practice trials presented with performance feedback (i.e., "correct" or "incorrect") prior to the test blocks. During the next 2 blocks of 6 test trials, participants did not receive feedback. Each block used one of two sorting criteria, either colour or shape (counterbalanced across participants). If children managed to pass these trials they moved on to the "Border Game" which included 12 trials; 6 cards had borders and 6 cards were from the colour and shape game trials. The cards were pseudorandomised, cards with borders were now the "Colour Game" and cards with no border were now the "Shape Game" (See figure 4.2). If children did not select the correct card on more than 2 consecutive trials the rules of the game were repeated before moving on to the next trial. There were no breaks between blocks or other indications to the participant that there were blocks of trials. The

total duration was approximately 10 minutes. Due to all children passing the first two trials scores were analysed from the border task only. Performance on the border version is scored as the number correct out of 12. Children are considered to pass this task if they sort nine or more cards correctly out of 12 test trials.

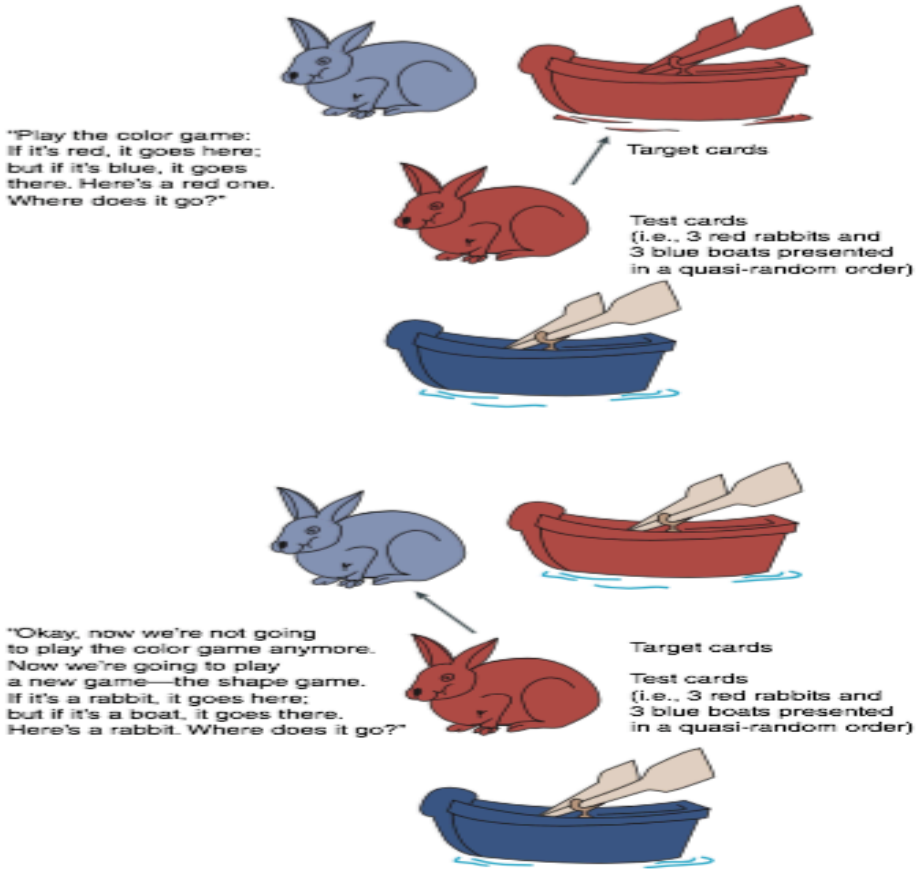


Figure 4.1: Sorting Game Illustration (Zelazo, 2006)

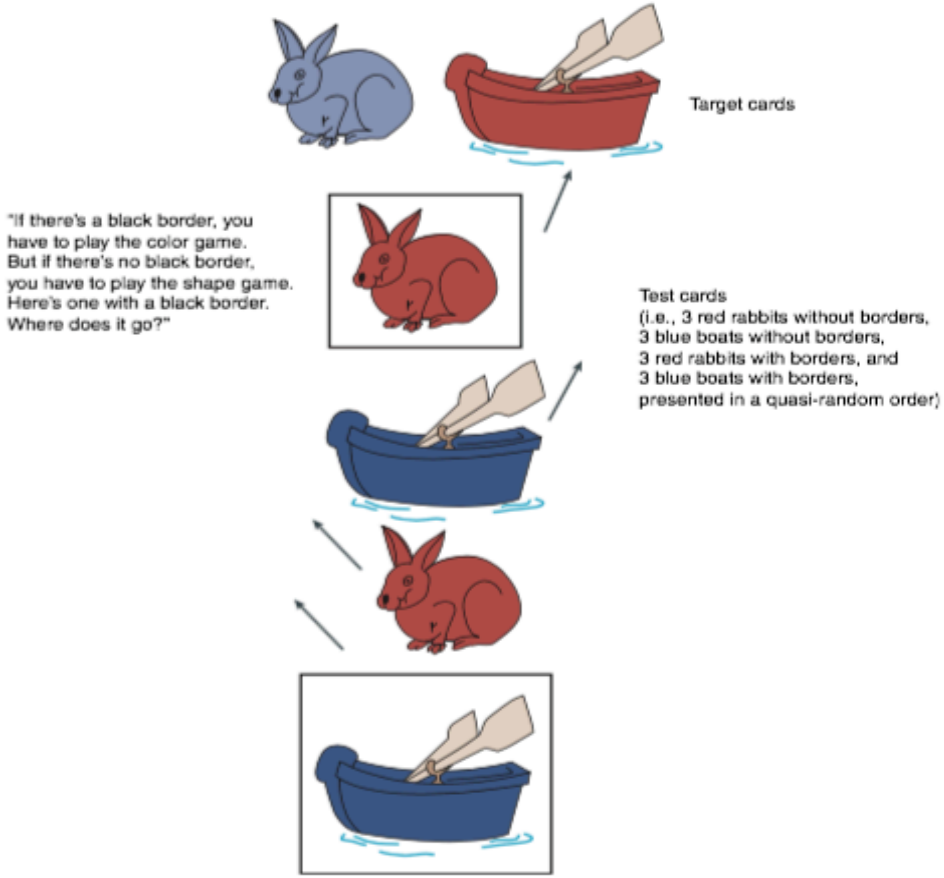


Figure 4.2: Border Game Illustration (Zelazo, 2006)

Classic Colour Stroop Test (Measures Inhibition)

The classic colour Stroop test from the PEBL test battery was employed (http://peblblog.blogspot.co.uk/2010/05/stroop-test.html). The classic Stroop is a reliable measure of the standard PEBL stroop test compares colour naming versus word naming under three response conditions (impacting what the screen looks like). The 3 conditions are: *Congruent:* In this condition, the colour name and the colour of the font are the same. For example, when presented with **BLUE**, the correct answer is "blue." Participants can respond quickly because the word and the font colour match. *Incongruent:* In this condition, the colour name and the colour of the font differ. For example, when presented with **BLUE**, the correct answer is "red." Participants take longer to respond because the word and the font colour do not match; reading the word interferes with identifying the font colour. *Neutral:* in this condition, words of everyday objects that are not semantically related and do not relate to a colour are used. For example: using the colour blue for the word **SHEEP** (the correct response is 'blue').

Go/No-Go (Measures Inhibition)

The Go/NoGo task from the PEBL battery was employed. It is a response inhibition task where a motor response must either be executed or inhibited. During this task, child participants were required to watch a consecutive presentation of letters and respond to a target letter by pressing a button. The presentation began with a 2 × 2 display of four stars (one in each square of the display). A sole letter (P or R) was then presented in one of the squares for a duration of 500 milliseconds with an inter-stimulus interval of 1,500 milliseconds. In the first condition (P-Go), child participants were asked to press a button in response to the target letter P and withhold their response to the non-target letter R. The ratio of targets to non-targets was 80:20. The first condition consisted of 160 trials. Next a reverse condition (R-Go) was administered, and child participants were asked to make a response to the target letter R and withhold a response to the non-target letter P (the letter that they were initially conditioned to make a response to in the earlier, P-Go condition). The ratio of targets to non-targets stays exactly the same during the reversal (R-Go) condition (ratio of targets to non-targets-80:20). Collectively, the two conditions contained 320 trials in total. Before the task, the instructions were explained to the child participants and they were administered a brief practice session to ensure the task was fully understood. Behavioural performance of the task was assessed by calculating four

values in each condition: (1) correct responses to the target (Go) letter (hits); (2) errors of omission (misses) to the Go letter; (3) errors of commission (false alarms) (i.e. responding incorrectly to the No-Go letter); and; (4) correct rejections to the No-Go letter. In addition, reaction time (RT) and RT variability to the Go letter was assessed and calculated for each participant. For the present study, a combination of Go/no-Go errors were calculated and analysed.

Table 4.2: Task Counterbalancing Sequences

Place of task in Sequence	Sequence 1	Sequence 2	Sequence 3	Sequence 4	Sequence 5
1st	DCCS	Role -Play	Go/No-Go	Strange Stories	Stroop
2nd	Go/No-Go	Strange Stories	Stroop	Role-play	DCCS
3rd	Stroop	Go/No-Go	Role-play	DCCS	Strange Stories
4th	Strange stories	Stroop	DCCS	Go-no-Go	Role-play
5th	Role-play	DCCS	Strange Stories	Stroop	Go/No-Go

4.4: Results

Table 4.4: Means (SD) of study variables.

Variable	6-7-year-old Mean (SD)	8-9-year-old Mean (SD)	Total Mean (SD)
Computer Mediated Role -Play 9 (IF: Max Score 26, Higher Score = more IF)	10.07 (6.29)	6.79 (5.37)	8.71 (6.106)
Strange Stories (ToM: Max Score 22, Higher score = better ToM)	11.39 (5.014)	13.93 (3.89)	2.44 (4.69)
DCCS (Cognitive flexibility: Max score 12)	7.95 (2.44)	8.83 (3.013)	8.31 (2.71)
Stroop Errors (Inhibition: Max Errors 80)	43.49 (26.99)	28.17 (18.88)	37.14 (24.99)

Go/No-Go Errors (Inhibition: Max Errors 320)	46.82 (22.68)	49.38 (23.71)	47.89 (22.98)

4.4.1: Associations of IF/DSE and Social Vulnerability

There was a negative correlation with the strange Stories [r = -0.51, p < 0.001].Age, [r = - .31, p = .005] and Cognitive flexibility (DCCS) [r = -.31, p = .004].Associations for gender, IQ, and inhibitory control (Stroop errors and Go-No-Go errors) were not statistically significant: Gender [r -.011, p =.08], IQ (FSIQ -WASI-II) [r = -.187, p = .06], Inhibition (Stroop total errors) [r= -.044, p = .359], and (Go/No-Go total errors) [r =-.142, p = .120].

Thus, a significant negative relationship of social vulnerability was found for age and both ToM and cognitive flexibility. This means that children who scored low on these tasks scored high on levels of social vulnerability and vice versa see table 4.4 for descriptive statistics.

4.4.2: Analysis, Predicting social vulnerability/IF

Multiple regression was conducted using the entry method, Strange Stories, DCCS, age, gender, IQ WASI, Go-no-go and Stroop were entered. One variable may be entered into the regression model per N=10 (Brace, Kemp & Snelgar 2016). An analysis of standard residuals was carried out, which showed that the data contained no outliers (Std. Residual Min = -2.0, Std. Residual Max = 2.59).

Tests to see if the data met the assumption of collinearity indicated that multicollinearity was not a concern (Strange Stories: Tolerance = .74 VIF:1.34, DCCS: Tolerance: .76 VIF: 1.31, Age: Tolerance = .76 VIF:1.30, Gender: Tolerance .89 VIF: 1.13, IQ WASI: Tolerance: .84 VIF: 1.19, Go-no-Go errors: Tolerance: .95 VIF 1.1 and Stroop errors: Tolerance: .77 VIF: 1.29.

The data met the assumption of independent errors (Durbin-Watson value = 2.22).

The histogram of standardised residuals indicated that the data contained normally distributed errors, as did the normal P-P plot of standardised residuals, which showed points that were not completely on the line, but very close.

The "scatterplot of standardised residuals" showed that the data met the assumptions of homogeneity of variance and linearity.

The data also met the assumption of non-zero variances, therefore, all assumptions have been met to carry out multiple regression analysis.

Using the enter method it was found that ToM (Strange Stories) age, gender, Cognitive flexibility (DCCS), and inhibitory control (Stroop errors and Go-NoGo errors) produced a significant model predicting social vulnerability (Computer mediated role-play Measure) [$F(7,69) = 4.17$, $p = .001$, $R^2 = .33$, $R^2_{Adjusted} = .26$]. This accounted for 26% of the variance.

The analysis demonstrated that ToM (Strange Stories), significantly predicted social vulnerability [$b = -.54$], Standardised [$\beta = -.411$ $t(63) = -3.41$, $p = .001$]. This supports the hypothesis that ToM will significantly predict social vulnerability/IF as measure by the computer mediated role-play scenarios.

The results for the DCCS [$b = -.38$] Standardised [$\beta = -1.70$, $t(63) = -1.43$, $p = .16$], age [$b = -.94$] Standardised [$\beta = -.16$, $t(63) = -1.32$, $p = .19$], gender [$b = -.16$] Standardised [$\beta = -.01$, $t(62) = -.118$, $p = .91$], IQ WASI [$b = .00$] Standardised [$\beta = .00$, $t(63) = .03$, $p = .98$], Go-No-Go [$b = -.05$] Standardised [$\beta = -.17$, $t(63) = -1.606$ $p = .11$] and Stroop [$b = -.02$] Standardised [$\beta = .081$] were statistically non-significant predictors of social vulnerability. This means that the hypotheses suggesting that age, and inhibition were not supported by this data.

Table 4.5: Multiple Regression Analysis of IF/ Social Vulnerability (Computer mediate role-play)

	t	*p*	*b*	SE *b*	β	*F*	*df*	*p*	Adj. R^2
Total Child Social Vulnerability Score (Overall Model)						4.17	7,69	.001	.26
Strange Stories	-3.41	.001	-.535	.157	-.411				
DCCS	-1.43	.158	-.384	.269	-.170				
Age	-1.32	.193	-.949	.722	-.156				
Gender	-.118	.907	-.160	1.359	-.013				
IQ WASI	.031	.957	.001	.042	.004				
Go-no-Go (Total errors)	-1.606	.113	-.046	.028	-.172				
Stroop (Total errors)	-.682	.498	-.020	.029	-.081				

4.4.3: Summary of Results

The results revealed that ToM as measured by the Strange Stories was the only variable significantly contributing to the variance, indicating that having poor ToM is a statistically significant predictive factor of social vulnerability see table 4.5 for multiple regression summary. This supports the hypothesis that ToM will significantly predict social vulnerability/IF as measure by the computer mediated role-play scenarios. The hypotheses suggesting that age, and inhibition were not supported by this data. There was a relationship of social vulnerability/IF with the DCCS, although this was not a predictive factor.

4.5: Discussion

The results of this study strongly confirm the relationship between ToM and social vulnerability/ IF as measured by the computer mediated role-play task found in study one

in that the results demonstrate that ToM is a predictive factor. Having good ToM abilities appears to be an important protective factor in children who demonstrated good social understanding and navigated the role-play scenarios in a way that would help them to stay safe if they were in real-life situations. This result supports the hypothesis that ToM will significantly predict social vulnerability/IF as measure by the computer mediated role-play scenarios.

Thus, this finding is strongly supported by and adds a new dimension to literature discussed in the previous chapter which demonstrate that ToM predicts multiple aspects of children's social skills and competencies (Astington 2001; Caependale & Lewis 2006: Huges& Leekam 2004: Jenkins & Astington 2000; Wimmer and Perner 1983; Wellman 2018).

Correlational results demonstrate a significant relationship of cognitive flexibility and social vulnerability, which is supported by a number of previous studies who found evidence of a relationship between social interaction skills and executive function Carlson & Moses, 2001; Moses & Tahiroglu, 2010; Sabbagh et al., 2006). None of the measures of EF employed in this research were significant predictors of social vulnerability/ indiscriminate friendliness which does not support the hypothesises that inhibition and cognitive flexibility were predictive factors of social vulnerability/IF as measured by the computer mediated role-play scenarios.

These findings are contrary to the findings from Bock et al., (2009) who suggested that EF predicts social understanding. Thus, this finding arguably adds to the literature that suggests EF may be necessary in influencing social interaction skills, but EF is not the main mediating factor (Sabbagh et al., 2006; Miller, 2009).

There was also a correlation with age, but again, age was not a predictive factor, this may be due to the children being quite close in age, individual differences and/or the simplicity of the role-play game may have been a factor. This does not support the hypothesis that age would be a predictive factor of social vulnerability/IF as measured by the computer mediated role-play scenarios. Finally, IQ as measured by the WASI was also a non-significant predictor. This is a good finding as it can be argued that poor intelligence and/or general cognitive ability is not a contributing factor in children who display indiscriminate and socially vulnerable behaviours.

Here the results demonstrate that poor ToM ability is a strong predictor of social vulnerability and vice versa. Thus, confirming that having a good ToM understanding is

likely to be a protective factor of IF and general social vulnerability. This means that improving ToM abilities could help to keep vulnerable groups of children safer, particularly in social situations with peers and adults out with the family environment.

Chapter 5: Study 3: Investigating IF using computer mediated role-play in looked after children: The role of inhibitory control and ToM

5.1: Introduction

As discussed in the general introduction, with the publication of the 2013 version of the DSM-V there has been a recent interest in investigating DESD as a separate disorder to RAD (APA, 2013). DSED/ IF can result from or leave children vulnerable to child abduction and/or abuse. These are amongst the most common offences committed against children (NSPCC, 2014). In middle childhood, however, children's social understanding and atypical behaviour patterns have proved difficult to assess. Currently, IF is assessed qualitatively via observation or interview, or through teacher, parent or guardian questionnaire (e.g. Bennett et al., 2009; Bruce et al., 2009; Lawler et al., 2014). As discussed in the general introduction it is difficult for children to express their real-life behaviours in an interview situation and relying on parent and teacher reports means the researcher and/or clinician cannot directly assess the child's behaviour in real world situations. So, we need alternative objective measures that accurately and directly assess the behaviours of these children. DSED/IF is prevalent because of the high levels of abuse and neglect experienced by children in the care system (Love, Minnis, and O'Connel 2015; Miellet et al., 2014; Kay & Green 2016).

Since July 2016, 17.349 children in Scotland were looked after (LAC) or on the child protection register, with 15,317 of these being considered LAC. This amounts to around 2% of all children in Scotland (Scottish Government Statistics, 2017). There are numerous types of placement which LAC can be placed, including at home (where a child is subject to a Compulsory Supervision Order and remains in their usual place of residence), foster care, residential unit or school, a secure unit or a kinship placement, where they are placed with family friends or relatives (Scottish Government, 2017).

DSE/IF is related to abuse and/or neglect from early childhood, rather than being an attachment related issue, as was previously the most pervasive school of thought (e.g. Bruce et al 2009: Love, et al., 2015; Gorter et al., 2017). DSED/IF has been notoriously difficult to investigate and was somewhat overshadowed by attachment related research. This is because many of the issues in pinning down DSED/IF to a single cause come from the fact that the children (e.g. looked after or institutionalised children) at risk of developing these behaviour patterns are an equifinal population that do not develop in the same way. The strengths and difficulties of this group reflect the influence of a combination of biological, personal, social and cultural factors (Luke & Banerjee 2013b).

In the context of the present research this means that not all at risk children will become indiscriminately friendly and may for example demonstrate an opposite pattern of inhibited behaviours now known as RAD (DSM V, APA, 2013) or display no obvious symptoms at all. This means that even if the same/similar environmental experiences are shared there is also the issue of multifinal outcomes cause by other unique factors such as genetics. Children with RAD benefit considerably from consistent care giving such as being adopted and forming attachment to a caring family, and gradually the patterns disappear (van Ijzendoorn & Juffer 2006). As of yet, there is no confirmed effective intervention to tackle DSED/IF. Further, these behaviour patterns can persist into late adolescence and adulthood even when a secure caregiver is found in childhood (Gleason et al., 2011). These behaviour patterns can leave children socially vulnerable and unable to form appropriate relationships with peers and potential partners, therefore, it is of much importance to investigate the underlying behavioural predictors in order to advise on appropriate intervention strategies (Smyke et al., 2012).

There are many studies that investigate the general cognitive and social impairments in children who have suffered early adversity through maltreatment from caregivers or from being institutionalised. As discussed at length in the general introduction, these studies suggest that amongst other factors social understanding, general proficiency in getting along with peers (Banerjee, Watling, & Caputi, 2011; Bennett et al 2009; Dunn & Cutting, 1999; Hughes, 2011; Luke and Banerjee 2013a) and issues with mental state understanding/ToM are an issue (Cicchetti et al, 2003; Covert et al., 2008; Kay & Green 2016; Pears & Fisher 2005). Also, the main cognitive impairment in those with DSED/IF symptoms or those who are in and out of care homes is inhibitory control, over and above other executive functions (Bruce et al., 2009; Gorter et al., 2017).

Furthermore, in a review where the researchers selected 10 high quality research papers by Love et al., (2015). To determine the quality of the research that was included the Downs and Black (1998) checklist was employed. This uses a modular approach that focuses on the following dimensions for considering the quality of a research paper: reporting bias, external validity, internal validity, selection bias, and power. This research suggested that factors associated with IF in fostered and institutionalised children are quality of care (e.g. emotional availability of parents), genetic predisposition, length of time for those who had been institutionalised and also confirms the existence of issues with inhibitory control.

At present, it is unclear if issues with social cognition are related to DSED/IF specifically, or early adversity and maltreatment in general. Kay and Green (2016) investigated ToM (Strange Stories) in adolescents in out of home care in comparison to a low risk control (LRC) group. They found that the former is the case and that although poor ToM understanding appeared to be a key issue for this group, Kay and Green state that their findings may not be directly related to DSED behaviours within this sample, because the ToM scores could be related to another factor/issue that affects LA children. Other measures of mentalising issues in the sample were confirmed to play a role in DSED. The complex results of this research confirm that ToM plays a mediating role in DSED but is also related to other aspects of maltreatment rather than DSED alone. Kay and Green suggest that research employing novel real-life social scenarios may be beneficial in exploring IF further. These latter findings were not available at the time of carrying out the present research in 2015/16.

5.1.1: Present study

To explore IF in middle childhood and also to validate my computer mediated role-play scenarios, I investigated these behaviours in a group who are most likely to benefit from the assessment and intervention recommendations from the research findings. The present study aimed to compare performance on the computer mediated role-play IF task between a group of looked after children (LAC) with age, gender and IQ matched low risk children (LRC) as a control group. This is because previous research highlights that children in care and/or those who have been maltreated are more likely to suffer from IF in comparison to low risk peers (Bennett et al., 2009; Lawler et al., 2014; Love et al., 2015; Minnis et al., 2007).

The relationship between the computer mediated role-play IF score, ToM, inhibitory control and the RPQ will also be investigated. As stated in the literature review above previous research suggests that children who have suffered from adversity through maltreatment from caregivers etc. have issues with social understanding and mental states understanding/ ToM (Cicchetti et al, 2003; Covert et al., 2008; Kay & Green 2016; Pears & Fisher 2005).

Previous also suggests that there is a link between social understanding and inhibitory control in groups of children who have experience neglectful home/care environments (Bruce et al., 2009; Gorter et al., 2017).

Thus, it is hypothesised that:

There will be a negative relationship between how the children perform on the computer role-play scenarios (measure of DSE/IF) with: Strange Stories (ToM)Executive Functioning (Inhibition: Stroop, Go/No-Go tasks).

There will be a relationship between how the children perform on the computer role-play scenarios (measure of DSE/IF) with the RPQ's.

I also predict that that there will be group differences in performance with LAC's performance being poorer on computer role-play scenarios measuring IF, Strange Stories (ToM), RPQ scores and inhibitory control measures (Stroop Go/No-Go) than LRC.

5.2: Method

5.2.1: Participants and Design

Table 5.1: Participant Characteristics

	Total N	Age Range	Mean (SD) Age in Months	Mean (SD) WASI FSIQ	Total RPQ	
					Teacher	Parent
LRC	14	6.3-11.7	7.8 (1.63)	93.86 (12.67)	1.86 (3.18)	.79 (1.31)
LAC	11	6.5-11.7	8.2 (1.66)	94.36 (10.45)	13.55 (7.12)	9.91 (5.24)
				P =.941		
Overall	25	6.3-11.7	7.98 (1.62)	94.08 (11.51)	8.88 (9.71)	5.84 (6.66)

A total of 25 participants took part in the present study: the typically developing group comprised a group of Low risk children (LRC Control) who had lived at home with their biological parents from birth. The second group of 11 were LA children. The 11 LA children had different LAC status. Four of the children were living with foster carers on a permanent basis, one of these who had been in foster care since infancy was soon to be adopted by his long-term foster parents. For this group of children written consent was gained from their social worker, who was contacted by either the school head teacher or foster parent. Another three of the children were in foster care on a part-time basis (i.e. visited a respite foster carer) but were still in regular contact with their birth parents and/or lived with their birth parents for the majority of the week under a compulsory supervisor order. For this group of children written consent was gained from their biological parent(s) who was contacted either by the school head teacher or via their social worker. The final four children were considered to be in kinship care, because they had been placed into the care of a family friend or relative (most commonly a grandparent or aunt/uncle). For this group of children written consent was gained from their kinship carer who is considered a legal guardian and was contacted by each school's head teacher.

All teachers and carers who I met in person commented on how each child had faced many challenges and hardship from a young age. It was also noted during testing

that the majority of this group displayed behavioural issues with teachers and peers in the classroom environment but seemed to enjoy the one-to-one testing sessions with myself. A between groups design was employed where each child was part of either the LRC or LAC group.

5.2.2: Materials & Procedure

After ethical approval was granted, the first stage of recruitment involved a formal approach to 4 Local Education Authorities (LEAs) in Scotland who were contacted in writing to request permission to undertake research in schools or via Social Services/Children and Families Service.

Once permission had been granted by these LEAs, permission was sought and granted via letters to Head Teachers from each LEA, and schools were chosen on an opportunistic basis. Written consent was sought from parents/guardians/social workers of participants. Parents/Guardians/Social workers and teachers were asked to complete the RPQ, which is described in chapter 3 of this thesis. In addition to this the RPQ's were divided into inhibited and disinhibited subscales for the purpose of the analysis. In the Teacher RPQ there are 21 of each sub item on the questionnaire and 15 of each sub item on the parent questionnaire.

Child assent was sought verbally on the day of testing. The majority of the children in the LAC group scored higher on the RPQ for the disinhibited subscales, only one child from the LAC group scored higher on the inhibited subscales, although, clinical diagnostic information was not available for the children in this sample.

Following LEA approval and the granting of Head Teacher and parent/guardian/ social worker permission, I obtained a list of the pupils whose parents/guardians/ social workers had consented to their child's participation from each of the 3 schools.

The remainder of the procedure and materials is similar to the study in chapter 4 of this thesis, except the children in this study did not complete the DCCS as it was felt that some of the children were developmentally too old for this task.

Once each LAC child was identified their class teacher was asked by myself if they could issue information letters and consent forms to children in the classroom who lived with their biological parents with no history of local authority involvement in their care and that have not been adopted. It was also asked that the children had a similar "twin" like ability level on academic subjects, the same gender, and who were no more

than 6 months older or younger in age to the LAC child they would be matched with. This was for the purposes of matching on IQ with the WASI. In most cases a match was found in the same class as the LAC child, but in 3 cases the recommended children were not a WASI match and children from another school in a similar/the same socio-economic area were matched to these children based on the above criteria. WASI score [t (23) -.107, p = .941].

Data were collected from each participant in one or two testing sessions during the school day lasting approximately 2 hours in total.

5.3: Results

All statistical analysis was carried out using IBM SPSS version 22.

5.3.1: Tests of Associations on task performance

Table 5.2: Pearson's Correlations (N= 25) Between Computer Mediated Role-play Scenarios (IF) and Key Study Variables.

	r	*p*
Strange Stories (ToM)	-.766	.000***
RPQ Teacher	.696	.000***
RPQ	.695	.000***
Parent		
RPQ Teacher	.702	.000***
Disinhibited Items		
RPQ Parent	.629	.001**
Disinhibited Items		
GO/No-Go (Inhibition)	.248	.231
Stroop (Inhibition)	.320	.119

P <.001***, *P* <.01**, *P* <.05*

On the overall sample (N= 25) significant correlations between the computer mediated role-play Scenarios (IF) with the Strange Stories (ToM). This confirms the hypothesis that there would be a relationship between ToM and social vulnerability/IF as measured by the computer mediated role-play scenarios.

The RPQ teacher and parent scores were also related to social vulnerability/IF as measured by the computer mediated role-play scenarios which supports the hypothesis that the scores on the RPQ will be related to performance on the computer mediated role-play scenarios. There was no significant relationship of social vulnerability/IF as measured by the computer mediated role play scenarios with either the Go/No-Go or the Stroop. Thus, the hypothesis that inhibition would be related to social vulnerability/IF was not supported. (see table 5.2).

Table 5.3: Pearson's Correlations (N= 11) Between Computer Mediated Role-play Scenarios (IF) and Key Study Variables for LAC group.

	r	***p***
Strange Stories (ToM)	-.648	.031*
RPQ Teacher	.695	.018*
RPQ	.811	.002**
Parent		
RPQ Teacher	.714	.014*
Disinhibited Items		
RPQ Parent	.641	.034*
Disinhibited Items		
GO/No-Go (Inhibition)	.245	.467
Stroop (Inhibition)	.634	.036

P <.001***, *P* <.01**, *P* <.05*

For the LAC there were significant correlations between the computer mediated role-play Scenarios (IF) with the Strange Stories (ToM). This confirms the hypothesis that there would be a relationship between ToM and social vulnerability/IF as measured by the computer mediated role-play scenarios.

The RPQ teacher and parent scores were also related to social vulnerability/IF as measured by the computer mediated role-play scenarios which supports the hypothesis that scores on the RPQ will be related to performance on the computer mediated role-play scenarios. There was no significant relationship of social vulnerability/IF as measured by the computer mediated role play scenarios with the Go/No-Go, but there was a significant relationship of social vulnerability/IF with the Stroop test. Thus, the hypothesis that inhibition would be related to social vulnerability/IF was partially supported. (see table 5.3).

Table 5.4: Pearson's Correlations (N= 14) Between Computer Mediated Role-play Scenarios (IF) and Key Study Variables for LRC group.

	r	*p*
Strange Stories (ToM)	-.740	.000***
RPQ Teacher	.783	.000***
RPQ	.815	.000***
Parent		
RPQ Teacher	.704	.000***
Disinhibited Items		
RPQ Parent	.691	.001***
Disinhibited Items		
GO/No-Go (Inhibition)	.031	.916
Stroop (Inhibition)	.007	.982

P <.001***, *P* <.01**, *P* <.05*

For the LRC significant correlations between the computer mediated role-play Scenarios (IF) with the Strange Stories (ToM). This confirms the hypothesis that there would be a relationship between ToM and social vulnerability/IF as measured by the computer mediated role-play scenarios.

The RPQ teacher and parent scores were also related to social vulnerability/IF as measured by the computer mediated role-play scenarios which supports the hypothesis that the scores on the RPQ will be related to performance on the computer mediated role-play scenarios. There was no significant relationship of social vulnerability/IF as measured by the computer mediated role play scenarios with either the Go/No-Go or the Stroop. Thus, the hypothesis that inhibition would be related to social vulnerability/IF was not supported. (see table 5.4).

In order to demonstrate consistency with previous research (although not a main hypothesis) the results revealed a statistically significant negative relationship with the Strange Stories and the Stroop test for the LAC group [*r* = -775, N=11 *p* = .005.] There were no statistically significant relationships with the Strange Stories (ToM) and the RPQ in the LAC group N = 11; RPQ-T; [*r* = -.239 *p* = .478], RPQ-P; [r =-.369, *p* =2.64], T-RPQ-D [*r* = -.082, *p* =.810], P-RPQ-D; [*r* = -.096, *p* = .780].

Table 5.5: Mean (SD) by Group (LRC, LAC) on Key Study variables

	LRC Control Mean (SD)	LAC Mean (SD)
Strange Stories (Max Score 22, Higher score = better ToM)	12.29 (5.25)	7.82 (4.42)
RPQ Teacher (T-RPQ: Max Score 42)	2.29 (3.36)	17.27 (8.55)
RPQ Parent (P-RPQ: Max Score 30)	1.07 (1.64)	13.18 (6.11)
RPQ Teacher Disinhibited Items (T-RPQ-D: Max Score 21)	1.86 (3.18)	13.55 (7.12)
RPQ Parent Disinhibited Items (P-RPQ-D: Max Score 15)	.79 (1.31)	9.91 (5.24)
RPQ Teacher Inhibited Items (T-RPQ – I: Max Score 21)	.43 (.852)	3.45 (6.03)
RPQ Parent Inhibited Items (P-RPQ –I: Max Score 15)	.21 (.58)	2 (2.72)
Go/No-Go Errors (Inhibitory Control Max 320)	41.29 (18.96)	57.36 (31.32)
Stroop Errors (Inhibitory Control Max 80)	37.07 (22.61)	45.18 (26.40)

5.3.2: Test of differences between LRC and LAC groups

8 independent samples t-tests were carried out for each hypothesis related to the difference between the LRC and LAC groups. A significant difference in performance was found between the LAC and LRC control group [t (23) -2.508, p = .020, Cohen's d = 1.03]. (see Figure 5.1). There was also a significant difference of group performance for the Strange Stories [t (23) 2.258 p = .034, Cohen's d = 0.92]. Additionally, the same

analysis was carried out on the RPQ, for the RPQ measure leavens test for equality of variance was significant, therefore, data was corrected and taken from the equal variance not assumed row. T-RPQ = [*t* (12.43) -5.493, *p* =.000, Cohen's *d* = 2.42] and P-RPQ [*t* (11.54) -6.598, *p* = .000. Cohen's *d* = 2.71]. This demonstrates that there was also a significant difference between both groups on the disinhibited subscales of the T-RPQ-D [*t* (13.14) -5.063, *p* =.000 Cohen's *d* = 2.12], P-RPQ-D [*t* (10.99) -5.63, *p* =.000. Cohen's *d* = 1.08]. There was no significant difference between groups for the inhibited items of the RPQ; T-RPQ –I [t (10.31) -1.649, *p* = .129] and P-RPQ-I = [t (10.32) -1.805 *p* = .100.] There was also no significant difference between groups for the Go/No-Go [t (23) -1.590, *p* = .125] or the Stroop test [t (23) -.827, *p*= .417]. (See Table 5.5).

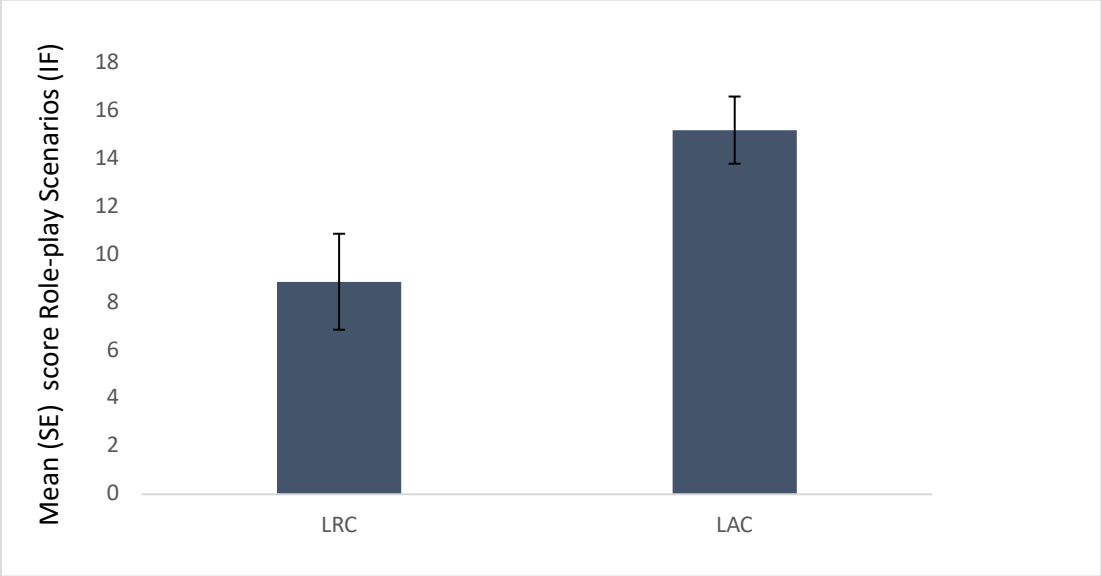


Figure 5.1: Mean (SE) Computer mediated role-play Scenarios (IF) between LRC and LAC groups (Higher score = more indiscriminately friendly behaviours).

5.3.3: Summary of Results

The results support a number of hypotheses and extend the results of the research in chapter 4. The hypothesis that ToM is negatively related to the IF score on the computer mediated role-play scenarios was supported. As hypothesised the scores for the computer mediated role-play scenarios were related to the children's total teacher and parent RPQ score and the score for the teacher and parent disinhibited subscales. Hypotheses for group differences were also supported: Children in the LAC group had significantly poorer performance on the computer mediated role-play IF, strange stories and RPQ

teacher and parent versions. The hypotheses for the Go/No-Go and Stroop test were partially supported with there being significant relationship between the computer role-play IF measure and the Stroop Test for the LAC group, however, the performance on these tasks did not significantly differ between groups.

5.4: Discussion

This is the first known research study to find empirical evidence that links ToM in LA children to real world social vulnerabilities.

The children in the LAC group of this study are placed under protection by their local authority because they have in the past been subjected to extreme maltreatment, such as neglect and abuse within the family environment. During their time in the care system many of these children have experienced frequent disruption with multiple moves between care placements. Indeed, even those under compulsory supervision may have been placed with a number of temporary foster carers to allow investigations to take place or to allow respite for their biological parent(s) who may be suffering multiple adversities. The mean age of this sample is approximately 8 years old meaning that the majority of these children have had LA status from a very young age, which previous research suggest leads to more severe behavioural issues such as DSED, and poorer social cognition and EF ability that can persist into adulthood (Rutter et al., 2007).

5.4.1: Group differences on Computer mediated role-play performance

The results of the present research revealed that the LAC group show significantly higher performance than the LRC group on the computer mediated role-play scenarios which measure IF/DSED through scenarios which reveal levels of social vulnerability. Thus, these results suggest that the LAC children do have increased levels of IF behaviours and are at risk of being socially vulnerable as measured by these scenarios in comparison to the LRC group.

The LAC group also revealed a significantly poorer performance on the Strange Stories, meaning that their ToM understanding was poorer than the LRC group. Despite the small sample size this finding is consistent with much previous research (Cicchetti et al, 2003; Colvert et al., 2008; Kay & Green 2016; Pears & Fisher 2005). This confirms that LAC children may have poorer competency in understanding the intentions of others within the context of social interactions. There is, however, much research to suggest that measuring ToM through a verbal measure such as the Strange Stories is problematic in

these groups of children because confounded language has been highlighted in previous research (de Villiers, 2007; Kay & Green 2016). Indeed, some research demonstrates that adolescents who have been in the care system may have poorer mentalizing abilities (in a truer to real life friendship interview setting) than matched controls even when controlling for language (Kay and Green 2016).

In the present study, group differences were also found with the RPQ teacher and parent versions and with disinhibited sub-items where the LAC group were reported as scoring significantly higher than the LRC group. No diagnostic claims can be made, but this nevertheless confirms the presence of DSED/IF behaviours within the LAC sample, which is supported by much previous research (e.g. Miellet et al., 2014).

The hypotheses that the groups would significantly differ on measures of inhibitory control via the Go/No-Go and Stroop test were not supported, which is contrary to much previous research (Bruce et al, 2009; Gorter et al., 2017). This could be due to the fact that children were closely matched on the WASI and IQ is known to underpin cognitive abilities (e.g. Ceci, 1991).

5.4.2: Relationships of the computer mediated role-play scenarios with social cognition and DSED/IF

The research also revealed a significant negative relationship with performance on the computer mediated role-play scenarios and the Strange Stories, for both LAC and LRC groups. This supports the finding in the previous chapter where a larger sample (N=70) confirmed that ToM predicts socially vulnerable/IF behaviours as measured by the computer mediated role-play task.

Significant relationships with the RPQS and the computer mediated role-play scenarios also further supports previous data presented earlier (in this thesis) that the role-play scenarios do to some extent measure aspects of DSED/IF. On this note, previous research does support these aspects of DSED. For example, Olsavsky, et al., (2013) who suggested that in more real-life settings, a lack of discrimination in response to strangers was associated with parent reports of IF. My computer mediated role-play scenarios aimed to capture this with scenarios that involved interactions with strangers after a "parent" has warned the child not to speak to any strangers. The children in the LAC group in the present study were less likely to consider the "parents" instruction and more likely to agree to the interaction with the stranger and were not as able to articulate the reasons why this may be an issue as well as the LRC group even when they expressed a

hunch that their initial decision to agree may have been wrong. Alternatively, it could be that LAC found the scenarios more difficult to relate to because the scenarios involved a number of "conventional" parent child interactions that they may not be as familiar with, in comparison to the control group.

Interestingly, although not initially a key hypothesis the results give further support for the behaviours measured in the computer mediated role-play scenarios in that they revealed no statistically significant relationship between ToM and the RPQs which supports previous research (Kay & Green 2016). Thus, this could mean that although LAC children have issues with ToM understanding this may indeed be a consequence of other aspects of being looked after/ maltreatment rather than the disinhibited behaviour itself. This gave some confirmation that the role-play scenarios in this thesis measure aspects of DSED/IF that are independent of ToM ability.

This finding has also highlighted that the correlation and predictive ability between ToM and the role-play scenarios may suggest that my scenarios go beyond the RPQ's in measuring DSED behaviours. In the sense that it measures many real-life social situations that can be problematic to those who display DSED behaviours and highlights the real-life impact of those with symptoms of DSE/IF. Other social issues may be intertwined with IF behaviours. Such as difficulties in effective social problem solving and issues with social reciprocity when interacting with others. I believe these are a key aspect of successfully navigating the role-play scenarios, along with having some ability to understand that another person's intentions may be different from their own.

5.4.3: Relationship of the computer mediated role-play scenarios with inhibitory control/EF

There was no relationship in the overall sample between the computer mediated role-play scenarios and the Go/No-Go and Stroop test. When the data from both groups was separated a significant relationship was found between Stroop errors and performances on the computer mediated role-play scenarios in the LAC group. This provides some support to previous findings that inhibitory control is an issue for children suffering from DSED/IF behaviours (Bruce et al, 2009; Gorter et al., 2017).

5.4.4: Practical challenges to completing the research

The vulnerable status of LA children in Scotland means access is necessarily difficult; their vulnerable status means that negotiations must be made with a number of gatekeepers (with other priorities), in order to collect data. The first hurdle is the complex ethical considerations of this research, the first stage involved gaining departmental ethics approval. Ethical consultation was outsourced to experts at The Centre for Excellence for Looked After Children in Scotland at The University of Strathclyde to ensure all ethical considerations had been met. Once these ethical considerations had been passed by the Psychology Department Ethics Committee at Heriot -Watt University, a number of organisations who are involved in the care of LA children in Scotland were approached to begin the recruitment process (Local Authorities and Barnardo's). Firstly, many local authorities were approached, each of whom had a different application process for gaining permission to carry out research. For example, some allowed access to the relevant education or children and family's departments via the submission of a research proposal, while others required their own ethics committee to review and approve the research. Some local authorities approve research on the basis of the projects ability to fit in with the themes of their current research targets (meeting these requirements can be a lengthy process for researchers). In other instances, local authority ethics committees make judgments on the bias of whether or not they felt the research was of good quality within the framework of their own professional background, this means that conflicting academic schools of thought can be a barrier to research access. Once research officials within the local authority's granted approval to carry out the research there are further hurdles, in many instances those who approve the research will leave it up to the researcher to source the participants on their own within the local authority, and no support is provided by way of contacts. Another complexity throughout this research was the inconsistencies and confusion (amongst professionals working with LA children and ethics comities) of whom was allowed to give consent for each child.

After gaining approval from some local authorities' I then wrote to many primary school head teachers. Each primary school in Scotland typically has a low number of looked after children and some have none. This information was not made available to me during the local authorities' research approval processes. Once schools with LA children had agreed to take part the child's social worker or named legal guardian was approached by the school head teacher to give information about the research and to invite

their child to participate. In some instances, this was a successful process, but many social workers refused to grant permission for the child to take part in the research, largely because they felt that particular children were too vulnerable and had been through too much adversity to take part in a research project. In other cases, local authorities were very keen to take part but after a long process of deliberation simply felt that they currently did not have the resources or capacity to take part in research. For this project carrying out research in local authorities was still the most useful strategy as the 11 LA children in the present study were recruited through the local authority in which they live. This strategy was advantageous as it meant that an age, gender and IQ matched control could be sourced more easily from the same classroom.

Another recruitment avenue that was explored was through the children's charity Barnardo's. The research experts at Barnardo's headquarters were keen on this project and its outcomes. As with some of the local authorities, Barnardo's has its own ethics process for conducting research within their organisation. Completing this ethics process was a 3-month process to gaining approval. The criteria for ethical approval at Barnardo's included elements that were different from the previous ethical committees that had already approved this project (e.g. the University and local authority's), again the charity appeared to be approving research within their own research framework and/or academic perspective of the committee members. Once ethical approval was granted by Barnardo's it is then up to the researcher to contact local Barnardo's social work managers, who are separate from the headquarters from which the ethical approval was granted and there is no communication regarding research projects between these groups, thus, more research approval steps were required at the level of the research manager.

I was successful at gaining Barnardo's research ethics approval and agreement to carry out the research by local social work managers. The different departments of the Barnardo's organisation are not linked up; therefore, the local social work manages did not understand the high level of expertise and scrutiny involved in gaining ethical approval from Barnardo's headquarters and took some weeks to consider the quality of the research for themselves. After satisfying the social work managers' queries, they then got in touch with a large number of social workers on my behalf, however, as with many working within the local authorities, the social workers felt that the children's lives were too chaotic, and they were too vulnerable to take part in research. This meant that after approx. 6 months of intense work with the charity no children were recruited from

Barnardo's. This highlights just some of the challenges faced when embarking on research with LA children.

5.4.5: Limitations and future research

In this research and in the literature in general, there are many gaps in reporting the potentially predictive variables. As discussed above it is plain to see (for those in the field) that this is not simply an oversight or bias in reporting, but access to samples of LAC and similar groups is necessarily difficult; their vulnerable status means that negotiations must be made with a number of gatekeepers (with other priorities) in order to collect data. So that in practice research such as the present study are only able to gain sample sizes that are often too small for researchers to sub-categorise children according to differences or interactions in some variables. This practical aspect of the research goes some way to explaining the tendency to report only an overall effect in studies with smaller samples, which means the heterogeneity in the sample here and in other research is not always obvious.

Even with the opportunity of access to larger samples, researchers need to come to a decision about which of the many potentially influential social, cognitive, environmental etc. differences between individuals might be worth examining. With these large samples being in short supply there is still much to learn about IF behaviour in LAC children.

Many of the results in this research are supported by previous research, meaning that the findings are promising in providing good validation for the computer mediated role-play measure of IF and social vulnerability, despite the low sample size. Future opportunities to carry out research using the computer mediated role-play scenarios in a larger LAC sample to support other potentially predictive variables would appear to be very useful, and highlight that further exploring how we can best help vulnerable children with improving social competencies in real-life situations would be valuable for maltreated groups of children.

The results of this research have also extended previous research on adolescents in finding similar social cognitive issues in younger looked after children. The next empirical chapter will explore other aspects of social and cognitive behaviour that may be predictors of IF and social vulnerability as measured by the computer mediated role-play scenarios.

5.4.6: Implications

The present study suggests that, ToM, practical reciprocal interaction and other social problem-solving skills may be a useful intervention for this group, indeed these intervention proposals are supported by the evidence provided in previous research (e.g. Kay and Green 2016). The research so far in this thesis has provided much validation for the computer mediated role-play measure. The role-play scenarios used in the present thesis are arguably an ideal tool to improve real life social competency issues in these groups, as well as measuring them. Further discussion of these ideas can be found in the general discussion of this thesis.

Chapter 6: Study 4: What best predicts IF: Emotional decision making or social cognition?

6.1: Introduction

Thus far, the key predictor variable in this research has been ToM as measured by the Strange Stories. This suggests that disinhibited behaviours and social vulnerability (as measured by computer mediated role-play) may be more strongly related to children's social understanding rather than cognitive factors. The present chapter aims to explore social and emotional predictors of the IF computer mediated role-play measure.

6.1.1: Hot Executive Function

Previous chapters have explored cool EF tasks as potential predictors of social vulnerability. Cool EF can be defined as the cognitive skills that are traditionally thought to encompass EF, such as inhibitory control and cognitive flexibility, when employed in affectively neutral situations (Zelazo & Muller 2002), however, no relationship between these measures and performance the computer mediated role-play scenarios was found.

Contrastingly, it is suggested that hot EF includes affective decision making and delayed gratification (Carlson, Zayas & Guthormsen 2009; Zelazo & Carlson 2012).

There is inconsistency within the literature, with some researchers arguing that social cognitive abilities such as ToM, emotional intelligence and moral judgment should be regarded as hot EF (e.g. Anderson, Anderson, Jacobs, and Spencer -Smith 2008). Other research evidence, however, suggests that these abilities are very closely related but cannot be characterised as hot EF (e.g. Kouklari, Thompson, Monks & Tsermentseli 2017; Zelazo, QU, Muller, 2005). For example, Kouklari et al., (2017) findings revealed that hot EF predicted ToM mental state and emotion recognition over and above cool EF in school aged children with and without ASD.

Considering that ToM appears to be a predictor of IF/ social vulnerability as measure by the computer mediated role-play task, it seems appropriate to explore hot EF. Cool EF has been strongly associated with academic achievement, while hot EF is strongly associated with children's disruptive and social behaviour (Brocki, Nyberg, Thorell, and Bohilin 2007; Garner & Waajid 2012; Willoughby, Kupersmidt, Voegler-lee and Bryant 2011). This suggests that hot EF is a potential predictor variable of the IF computer-mediated role-play measure in this thesis.

It is widely understood that children and adolescents engage in more risky decisions than adults (e.g. Sternberg, 2007). These risky decisions are more likely in

uncertain situations in which one's actions could not only have an instantaneous payoff but may also lead to negative outcomes in the long-term. Adolescents find it much more challenging to consider the future consequences of their behaviour, in a comparable way to high-stakes gambling (Carlso et al., 2009).

Research employing the delay of gratification hypothesis provides insight into the long-term outcomes associated with children's affective decision making. In the classic experiment (Mischel, 1974), children are given a choice, for example, one marshmallow now or two marshmallows later. Some children are able to wait to obtain the more valued reward, and others are not, instead opting to end the delay in order to eat the marshmallow they had already been given.

Individual differences in performance on this task at age 4 are diagnostic of long-term outcomes, including adaptive social, cognitive, and emotional functioning in later life. For example, children in this age group who were more successful at waiting for the second treat to arrive (delaying gratification) have been found as adolescents to be significantly more attentive, able to concentrate, and display better self-control in highly emotive situations (Shoda, Mischel, & Peake, 1990). They also scored higher on academic tests and were perceived as more interpersonally competent by parents and peers (Mischel, Shoda, & Rodriguez, 1989). As adults, they were less likely to abuse substances than individuals who had exhibited difficulty with the delay of gratification when aged 4-years-old (Ayduk et al., 2000).

As well as measuring delayed gratification, hot EF tasks measure emotive decision making. One of the most common measures of affective decision making in adults is the Iowa gambling task (IGT: Bechard, Damasio, Damasio, and Anderson 1994). For the purposes of this task participants are given four decks of cards. They select from a succession of cards within these decks to win as many points (represented by currency) as possible. Two of the card decks are disadvantageous as they result in both larger rewards, but occasional and unpredictably large losses, that in the end will result in a net loss, however, the cards in the advantageous decks yield both smaller rewards and also occasional smaller losses resulting in a net gain.

Research employing the IGT had demonstrated that adults within the healthy range make choices that are based on the long-term consequences and learn to pick the cards from the advantageous decks across trials. In contrast those with brian damage to the ventromedial prefrontal cortex (VMPFC) do not demonstrate the ability to learn which

decks are associated with long-term gains and continue to choose the disadvantageous decks (Berchard et al., 2004).

Evidence suggests that children show signs of developing the ability to detect long term costs and benefits as early as the nursery school years, which reflects the general shift in EF development from 3-5 years old. This research used a simplified version of the IGT. Children chose between two options one of which appears to be more attractive but is in fact costlier in the long run (Carlson, Davis, & Leach, 2005; Garon & Moore, 2004, 2007; Kerr & Zelazo, 2004). For example, on the Children's Gambling Task (Kerr & Zelazo, 2004) all children initially preferred the card deck with greater rewards (e.g. sweets) but only the older children (4-5-year olds) learned to make the most cost-effective decisions across the 50 trials in comparison to 3-year-olds.

Thus task is, however, not appropriate for older children in middle childhood and adolescence. Thus, Crone and collaborators (Crone, Bunge, Latenstein, & van der Molen, 2005; Crone & van der Molen, 2004) developed an adapted computerised version of the IGT suitable for school aged children. In contrast to the children's gambling task has four choices instead of two. The child participants are presented with 4 doors and instructed to select the doors in order to win as many apples as possible for a "hungry donkey" displayed on the computer screen under the doors. This task is similar to the IGT in that two of the doors are disadvantageous in the long run, as they produce high rewards on each trial (apples gained) but also result in large penalties (apples lost) on some trials. The other two doors are advantageous in the long run: They yield not only smaller rewards on each trial but also smaller losses. In this version of the task, the long-term consequences of the doors are crossed with the frequency of punishments, such that one of the disadvantageous doors and one of the advantageous doors result in frequent smaller losses, whereas the other two doors incur infrequent, large losses.

Performance on the Hungry Donkey Task (HDT) changes with age in two key ways. Firstly, children aged 6–18 years progressively learn to select from the advantageous doors in fewer trials, the youngest of these children select disadvantageous choices more often. One proposed account is that they have a hypersensitivity to go for the larger rewards upfront (Crone, Jennings, & van der Molen, 2004; Crone & van der Molen, 2010; Hooper, Luciana, Conklin, & Yarger, 2004; Overman, 2004). Secondly, in comparison with older adolescents and adults, children have a dislike doors that produce regular punishments (Crone & van der Molen, 2007; Crone et al., 2004; Overman, 2004). Consequently, they are initially likely to prefer the doors with infrequent losses,

predominantly because they appear to present instant rewards, over both the disadvantageous and the advantageous doors with frequent losses (Huizenga et al., 2007). With development, children are able to consider the future consequences of their decisions - because this task shows a developmental trajectory of performance. Some even related potential (ERP) evidence suggests that the HDT is significantly related to children's behavioural performance and verbal abilities, indicating that neuropsychological responses may be a manifestation of children's trait based and/or developmental level of decision-making skills in affective motivational situations.

6.1.2: Measuring Social Competencies

In addition to exploring affective decision making another aim of this research was to investigate children's general social abilities in relation to the computer mediated role-play task. It is widely accepted that children with superior ToM abilities tend to be most socially competent in reciprocal interactions and vice versa. The Social Responsiveness Scale (SRS: Constantino & Gruber, 2005) was developed to measure impairments in reciprocal social behaviours. The SRS is a 65-item questionnaire completed by parents or teachers. The test–retest reliability, inter-rater reliability, construct validity, convergent validity and internal consistency of the SRS in UK population samples of children aged 5-8 years old is high (Wigham, McConachie, Tandos & Le Couteur 2012). This test provides a quantitative measure of social responsiveness. It is largely used to assess the severity of ASD, by measuring social awareness, social cognition, social communication, social motivation and autistic behaviours observed in real-life situations. This measure can also be used for behavioural assessment and intervention validity purposed on population and group samples without ASD (Constantino et al., 2013). For example, Marshall et al., 2016 recently used the SRS- 2 to investigate the feasibility of a social stories' intervention in schools for children with and without ASD. There were a number of limitations due to following up the sample at a later date, but the results were generally positive and demonstrated a small improvement in teacher rated SRS scores as a result of the social stories intervention. Thus far the SRS-2s ability to predict indiscriminate friendliness or social vulnerability in typically developing children has not been investigated.

Hypothesis: It is expected that the DCCS, HDT and the SRS- 2 will be predictive of indiscriminate friendliness/ social vulnerability as measured by the computer mediated role-play task.

6.2: Method

6.2.1: Participants & Design

Table 6.1: Participant Characteristics

	Total N	N Male	N Female	Mean Age in Years and Months (SD)	SDQ Total
6-7	33	17	15	6.6 (.29)	12.00 (3.89)
8-9	20	6	15	8.6 (.29)	12.75 (4.76)
Overall	53	23	30	7.4 (1.03)	12.28 (4.21)

All participants completed the same tasks and were allocated to one of 2 age groups: 6-7 year and 8-9-year olds (See table 11). The child participants took part in 3 x tasks: 1 = DCCS, 2 = HDT, 3 = computer mediated role-play scenarios of social vulnerability/IF. The DCCS and HDT were counterbalanced across participants and the computer mediated role-play scenarios were presented either at the beginning or end of each session. Where possible children completed all tasks within one session. Each session lasted approx. 45 mins to 1 hour.

Each child's class teacher completed a questionnaire pack inclining the SRS-2 and the SDQ.

6.2.2: Materials & Procedure

The recruitment procedure for the present study was identical to that in chapter 4. In the present study, however, class teachers of the participating children also took part by completing the SRS-2 and the SDQ based on their knowledge of each child's behaviour. Consent was given verbally to myself and assumed by way of completing and returning the questionnaires. It was felt best to have teachers complete the questionnaires (rather than parents) since the children were being tested within the school environment and are more likely to display those behaviours, rather than those they display at home.

Measures

Computer mediated role-play measure of IF/DSE

The scenarios were the same as those used in chapter 4, however, this time at the end of the 'Security Gard' and 'Picnic' scenarios children who had agreed to go with the stranger were asked 'What did mum say earlier?' to check that there were no issues with memory. All children responded in a way that indicated they remembered that mum had instructed them no to talk to strangers.

Questionnaire pack completed by class Teachers

*Social Responsiveness Scale 2 (*SRS-2: Constantino & Gruber 2012) The Social Responsiveness Scale–Second Edition (SRS-2) is 65-item rating scale measuring deficits in social behaviour associated with Autism Spectrum Disorder (ASD), as outlined by the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association, 2000). The questionnaire can be completed by raters who have at least 1 month of experience with the child being rated. An "average reading ability" is thought to be necessary to complete the record forms (Constantino & Gruber, 2012, p.3). Since this research was carried out in the last term of the school year the class teachers would have had approx. 10 months experience of each child. The scale took approximately 10 min to complete per child.

T-scores of 76 or higher represent a severe score suggesting that an individual has clinically significant deficits in social functioning that impede interactions with others. Scores that fall between 66 and 75 are considered moderate, signalling some clinically significant social deficits. The mild range includes *T*-scores of 60 to 65, which indicate mild to moderate deficiencies in social behaviour. *T*-scores of 59 and below indicates an individual is unlikely to have social difficulties indicative of a possible ASD diagnosis. Reporting *T*-scores using the standard error of measurement is recommended to account for possible variability in calculating a given score.

All children who took part came within the normal range of T-scores, no children had a high score indicative of the issues with social functioning that are related to a clinical diagnosis of ASD. Four children in the present study indicated mild to moderate deficiencies in social behaviour. All other children had a T-score of below 59 meaning they do not have any indication of social difficulties related to an ASD diagnosis.

The SRS-2 has demonstrated good reliability and validity when assessing deficits in social behaviour associated with ASD (Constantino & Gruber, 2012).

Strengths and Difficulties Questionnaire

The Strengths and Difficulties Questionnaire (SDQ; Goodman, 2001) was used as a screening measures in the present study. The SDQ is a brief behavioural screening tool for a number of difficulties that may be experienced by children aged between 4 and 16 years old (Goodman, 2001). The SDQ examines 25 attributes, some positive and some negative. Items are divided between 5 behaviour domains: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems and prosocial behaviour (each domain is represented by 5 items). Scores from the first four of these scales are added together to generate a total difficulties score (based on 20 items). The SDQ has been widely used for a variety of research reasons and has demonstrated good reliability and validity (Goodman, 2001). Normative data are available for UK samples. The teacher version of the SDQ was used as a screening measure in the current study to ensure typicality of the sample in terms of behaviour. All children for whom consent had been obtained scored within the typical range on this measure and so no participants were excluded on this basis.

Tasks completed by the children

Computer Mediated Role-play (Measure indiscriminate friendliness)

The same scenarios and procedures that were employed in chapter 4.

Dimension Change Card Sort (DCCS: Measure Cognitive Flexibility)

This was a computer-based version of the same DCCS procedure used in chapter 4 of this thesis. This version of the task was created in PsychoPy which is free software for creating psychology and neuroscience experiments. In addition to the total score obtained by the manual version of the task the computerised version allowed the addition of reaction time as an outcome measure.

Hungry Donkey Task (HDT: Hot EF, Measures Affective Decision Making)

This task was taken from the PEBL battery of cognitive tasks and is based on research by Crone and Vander Molen (2010). The children were seated in front of a computer monitor. The stimulus display consisted of four doors presented on a horizontal row, A, B, C, and D, and a donkey head in front of the doors. An example of a stimulus/outcome display is obtainable in Figure 6.1. Participants were asked to assist the hungry donkey to collect as many apples as possible by pressing one of four keys corresponding to the doors. Children were able to use the laptop trackpad to click on each

door. Upon pressing one of the doors, the stimulus display was replaced by the outcome display showing the number of (intact) apples gained or the number of (crossed) apples lost behind the door. just above each door and a large horizontal bar was presented just below the donkey. The left halves of the bars were coloured green and the right halves were coloured red. Participants were told that the green halves of the bars indicated how many apples they had won, and the red halves indicated the number of apples lost. The bar provided this information averaged across options (see figure 6.1).

All participants performed two tasks: the standard task and the reversed task. Both tasks contained 200 trials. In the standard task, the win and loss schedule were similar to the one used by Bechara et al. (1994). That is, the relative proportions of wins and losses were identical to those used by Bechara et al. (1994) but the absolute amounts were reduced by a factor 25. The ultimate future yield of each door varied, because the wins were higher at the high paying doors (A and B), and lower at the low paying doors (C and D). Selecting door, A or B resulted in a gain of four apples, whereas door C or D resulted in a gain of two apples. After selecting 10 A-doors, the participant received 40 apples, but had also encountered five unpredicted losses of either 8, 10, 10, 10 or 12 apples, bringing the total cost to 50 apples, thus incurring a net loss of 10 apples. After selecting 10 B-doors, the participant received 40 apples but had encountered one unpredicted loss of 50 apples, also incurring a net loss of 10 apples. After, selecting 10 C-doors, the participant received 20 apples, but had encountered five unpredicted losses of 1, 2, 2, 2, or 3 apples, bringing the cost to 10 apples, incurring a net gain of 10 apples. The same happened at door D, except that instead of encountering five losses, there was one larger unpredicted loss of 10 apples. Thus, door D also resulted in a net gain of 10 apples. In sum, doors A and B were equivalent in terms of overall net loss over the trials. The difference was that at door A, the loss was more frequent, but of smaller magnitude, whereas at door B, the loss was less frequent but larger. Doors C and D were also equivalent in terms of overall net loss. At door C, the loss was more frequent and of smaller magnitude; at door D the loss was less frequent and of higher magnitude. Doors A and B were disadvantageous in the long run, because they resulted in a net loss; doors C and D were advantageous in the long run because they resulted in an overall gain.

In the reversed task, selecting door A or B resulted in a loss of four apples, whereas door C or D resulted in a loss of two apples. Again, the ultimate future yield of each door varied because the reward amounts were higher at high losing doors. After selecting 10 A-doors, the participant had lost 40 apples, but had also encountered 5

unpredictable gains of 8, 10, 10, 10 or 12 apples, resulting in a net gain of 10 apples. The same happened for door B, except that there was one large unpredicted gain of 50 apples. After selecting door C 10 times, the participant was faced with a loss of 20 apples and 5 unpredictable gains of 1, 2, 2, 2, or 3 apples, resulting in a net loss of 10 apples. After selecting the D-door 10 times, the participant lost 20 apples, and had encountered one unpredictable gain of 10 apples, also resulting in a net loss of 10 apples. Thus, in the reversed task, doors A and B were equivalent in terms of overall net gain over the trials. The difference was that for door A the gain was more frequent and smaller in magnitude, whereas at door B the gain was less frequent but higher in magnitude. Doors C and D were also equivalent in terms of overall net gain over the trials. At door C, the gain was more frequent but of smaller magnitude, and at door D the gain was less frequent but of higher magnitude. In this task, doors A and B were advantageous in the long run. Doors C and D on the other hand were disadvantageous in the long run.

Participants were instructed to assist the hungry donkey sitting in front of the doors to win as many apples as possible. They were told that donkey families were living behind the doors. In each family, there were nice donkeys that were willing to give some apples and nasty donkeys that were taking apples away. Selecting a door could, therefore, result in winning a certain number of apples or winning and losing apples. Following each selection, the number of intact apples (gain) and the number of crossed apples (loss) indicated the specific earnings. The participants used the laptops track pad to select to each door. They were told that they had to play many times but that they could switch between doors as often as they wanted. Their goal was to win as many apples as possible for the hungry donkey.

All participants were tested individually in a quiet room at each school. They performed the standard and reversed tasks in counterbalanced order. Both the standard and the reversed task took participants approximately 15 min to complete. After the completion of the standard task, participants were asked which door they preferred, and to provide a rationale for their preference. The participants were scored on whether or not they understood the aims of the game and/or which doors were advantageous. The qualitative responses gained from this were converted in to a dichotomous Yes or No variable, children only received a yes score if they correctly identified both advantageous doors.

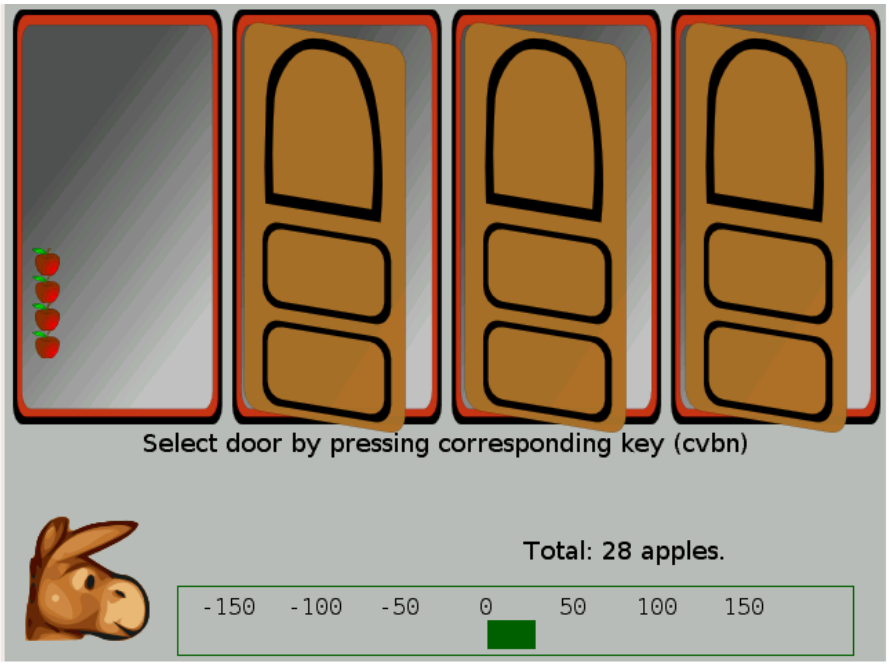


Figure 6.1: An example of a stimulus/outcome display in the HDT.

6.3: Results

6.3.1: Descriptive statistics

Table 6.2: Mean (SD) by age group (6-7, 8-9) on Key Study Variables

Variable	6-7-year-old Mean (SD)	8-9-year-old Mean (SD)	Total Mean (SD)
Computer Mediated Role-play (Measure of IF: Max Score 26, Higher Score = more IF)	7.27 (4.03)	6.20 (5.21)	6.87
SRS-2 T-score (Measure of General Social Cognition: Max Score 90)	43.74 (6.225)	43.35 (7.56)	43.72 (6.69)
HDT Total Score (Measures affective Decision-making Max score +/- 3000)	-247.48 (107.90)	-117.95 (306.227)	-198.60 (524.15)
HDT Advantageous Door Preference	1.33(.497)	1.30 (.470)	1.32. (471)
SDQ - Total score (Max Score 40)	12.00 (3.89)	12.75 (4.76)	12.28 (4.21)
SDQ- Emotional	.36 (1.59)	1.55 (2.35)	1.19 (1.91)
SDQ -Conduct	.97 (.91)	.55 (1.67)	.43 (1.23)
SDQ- Hyper	1.48(2.37)	1.60 (2.60)	1.53 (2.44)
SDQ - Peer Problems	.61(1.35)	.30 (80)	.49 (1.17)
SDQ – Pro Social	8.64(1.85)	8.75 (2.67)	8.68 (2.17)
DCCS – Total Score (Max Score 12)	6.79 (1.98)	6.80 (2.73)	6.792 (2.26)
DCCS - RT	2.78 (1.24)	2.74 (2.31)	2.7670 (1.69)

6.3.2: Associations of Social Vulnerability/IF:

Table 6.3: Pearson's Correlations (N=53) Between Computer Mediated Role Play Scenarios and key Study Variables

Variable	*R*	*P*
SRS-2 T-score	.521	.000***
HDT Total Score	-.138	.326
HDT Advantageous Door Preference	.511	.000***
SDQ - Total score	.264	.056*
SDQ- Emotional	.175	.209
SDQ -Conduct	.320	.020
SDQ- Hyper	.367	.007**
SDQ - Peer Problems	.133	.314
SDQ – Pro Social	-.302	.028*
DCCS – Total Score	.022	.877
DCCS - RT	.145	.299
Age in years, moths and days	-.126	.369
Gender	.034	.124

P <.001***, *P* <.01**, *P* <.05*

Pearson correlations revealed that the SRS-2 total score, HDT advantageous door preference, and the conduct, prosocial, and hyperactivity measures of the SDQ were significantly related to performance on the computer mediated role-play scenarios of IF/social vulnerability (See table 6.3).

6.3.3: Regression Analysis, predicting social vulnerability/IF

Those variables that were significantly correlated with the criterion variable, computer mediated role-play social vulnerability/IF measure were entered as predictors into a multiple regression using the standard enter method. The data met all necessary assumptions required to proceed with interpreting the regression model e.g. multicollinearity was not an issue, the data is normally distributed, assumptions of independent error, homogeneity of variance, linearity and non-zero variances were also met.

The multiple regression analysis revealed a significant model: [F (5,47) =6.65, p <.001.] The model explains 35.2% of the variance. In social vulnerability/IF as measured by Computer mediated role-play (Adjusted R^2 =.352). Table 6.4 gives information about regression coeficients for the predictor variables entered into the model. HDT advantageous door preference and SRS -2 T-score were significant predictors with a positive relationship to the computer-mediated role-play measure of IF/social vulnerability. The SDQ sub-scales of hyperactivity, conduct, and prosocial scales were not significant predictors.

Table 6.4: The unstandersised and standerdised regression coefficients for the variables entered into the model

Variable	*B*	SE B	β	*P*
SRS 2 T - Score	.259	.120	.386	.036*
HDT Advantageous Door Preference	3.474	1.138	.356	.004**
SDQ - Conduct	.514	.519	.141	.327
SDQ- Hyper	-.088	.305	-.048	.777
SDQ- Pro social	.007	.306	.003	.982

6.3.4: Summary of results

The results support the hypothesis that the SRS-2 is predictive of the scores on the computer mediated role-play scenarios. The hypothesis that HTD would predict scores on the computer mediated role-play scenarios was only partially supported. The total scores were not a predictor, however the ability to identify the most advantageous doors (doors yielding net gains) was a significant predictor variable. Subscales of the

SDQ were significantly correlated to the computer mediated role-play scenarios they were not predictive. The hypothesis that the DCCS would be a significant predictor variable was not supported by these findings.

6.4: Discussion

The results revealed that there are two key predictors of the computer mediated role-play IF scenarios, both the SRS-2 and children knowing the advantageous doors in the HDT, but the correlation of the DCCS from study 2 was not replicated. This provides validity to the computer-mediated role-play scenarios, as effective in measuring social aspects of children's behaviour.

Children who scored high on the SRS-2 also scored high on the computer mediated Role-play scenarios and vice versa. Class teacher observations of the children's in class social behaviour was reflected in their ability to navigate the role-play scenarios. This indicates that social awareness, social cognition, social communication and social motivation, as measured by the SRS-2 appear to be protective factors for children in real life situations where they could potentially become socially vulnerable. This finding is supported by previous research which demonstrates that teacher ratings on the SRS-2 are related to children's abilities on social stories (Marshall et al., 2016).

The findings demonstrate that children who knew the advantages doors in the HDT were better at successfully navigating the computer mediated role-play scenarios in a way that lead to safer outcomes, however, the total behavioural scores on the HDT were not predictive of IF/social vulnerability.

On a qualitative level many of these children still understood that they were making a poor choice. It was observed by myself, that children who learned they were selecting the disadvantageous doors would move onto the advantageous doors after experiencing the emotions of a large net loss. After selecting the advantageous doors for a while, these children could not resist another go at making a larger gain and would go back to the disadvantageous doors despite knowing the risk. As with high stakes gambling it appears that children in this age group are enticed by the greater up-front rewards and have a ‘‘myopia for the future’’ (Crone, Jennings, & van der Molen, 2004; Crone & van der Molen, 2004; Hooper, Luciana, Conklin, & Yarger, 2004; Overman, 2004) despite understanding the potential risk. This confirms the earlier argument in this thesis of children between the ages of 6-9 years old understand right from wrong when questioned by an adult, but do not always have the ability to behave in a way that reflects this understanding of risk in real life situations.

A correlation was found in study 2 between the computer mediated role-play task and cognitive flexibility as measured by the DCCS this was not confirmed in the findings here. Arguably this implies that cognition may only be a mediating factor of IF in some

instances. Research from study 3 suggests that the cognitive impairments may only be present in the most vulnerable children, therefore, further research should explore social vulnerability in these groups of children with a different battery of cognitive tests to help disentangle this link in more detail.

Again, as with pervious data in this thesis the findings support a predominantly social understanding of the computer mediated role-play scenarios. With the SRS-2 being a predictive variable this would suggest that exploring the computer-mediated role-play scenarios in future research on children with and without ASD would be worthwhile. This research also highlights the potential of the computer mediated role-play scenarios as an intervention tool to improve children's social competences. Cognitive intervention focussed on training children's behavioural response to risk and reward may be useful to promoting social safety skills in at risk groups of children.

Chapter 7: Study 5: The creation and evaluation of a bespoke serious game for the scenarios: A pilot Study

7.1: Introduction

As discussed in chapter one research exploring computerised alternatives to paper and pencil and doll house role-play games to measure social and attachment behaviours in children have demonstrated an ability to be useful and reliable in research with children (Minnis et al 2006; Minnis et al., 2010). As highlighted in the general introduction there has been a surge in the use of serious games in research with children and has demonstrated evidence of being a successful method of intervention in social interaction difficulties. Computer based psychological assessment has also been found to put children at ease because there is less focus on being in a 'test' situation (Truman et al., 2003; Minnis et al., 2010).

The research in the first empirical chapter (chapter 3) of this thesis was the first study to find that in comparison to a paper pencil story task, a computer mediated role-play task produced more ecologically valid results. Chapter 3 reviews the evidence that this difference may be due to the improved levels of psychological "presence". "Presence" is a state of consciousness; it describes the phenomenon of a gamer having the feeling of being in the virtual environment, and thus the corresponding behaviour should be more consistent with the real-world environment (Cummings & Baileson 2016).

In chapter 3 the Kar2ouche role-play scenarios arguably provide more psychological presence in comparison to the "paper pencil" task, where children reasoned from a 3rd person perspective. The mechanism of role-play appears to be important for allowing children to take a 1st person perspective and arguably achieves some of the effects of psychological presence in comparison to the story vignettes.

It is argued that although full immersion has its benefits for improving the feeling of psychological presence (Slater & Wilbur 1997), it is not always necessary to invest in the most advanced virtual reality equipment in order to achieve psychological presence and feelings of "being there" (Cummings & Baileson, 2016). So, current research into immersion and presence suggests that the theoretically driven pursuit to acquire the most advance systems should be balanced with practical constraints (Bowman & McMahan 2007).

In this sense, the computer mediated role-play scenarios have functioned well for the purposes of this thesis. The Kar2ouche software had many other advantages, for

example, this software is a licenced product with the primary purpose of being a children's story boarding game. The simplicity of being created for children was valuable in that I had the control to quickly develop and trial multiple different role-play scenarios without any computer programming expertise, meaning that any research team or clinician could quickly and easily adapt these scenarios to their needs. The software was originally developed with children in mind, thus, the primary school children in my research interacted with ease.

There were also some disadvantages, for example, the children were required to type their responses into speech bubbles, and although the majority of children were proficient in typing using a QWERTY keyboard and familiar with using a laptop computer, this did slow things down for the younger age group and in some cases led to children reducing their responses to the understanding aspect of interpreting the scenarios. This was somewhat mitigated by myself through encouraging the children to write more or to verbally say what they wanted to write in the speech bubbles. However, a system that could record these into the speech bubbles in real-time would have been very beneficial.

The computer mediated role-play appeared to put children at ease and reduce their awareness of being in a "test" situation in comparison to the paper and pencil version, however, stated above this software required my presence at all times to read out the narrative of each scenario and to help younger children with typing. The researcher not being completely removed could have led some children to feel they were still in a test situation, but everything possible was done to build a rapport with each child before commencing the research.

From a practical research perspective, the software was created in 1999-2001 meaning that it was very slow to run in comparison to more up-to-date software. A separate application was required for each scenario that was slow to load, thus, increased overall testing time in comparison to the paper and pencil vignettes.

An advantage over the paper and pencil vignettes was the ability to anonymously save each child's responses within the context of each scenario making the rating of responses at a later date easier. This was, however, somewhat impractical when sending the data to a second rater as a licence for Kar2ouche is required to open the data files and the files are too large to email all at once. This means that Kar2ouche was very useful for individual research purposes but for larger studies with multiple research team members

across different sites (especially for clinical or educational use in hospitals or classrooms respectively) there are aspects of the software that would not be practical. By creating bespoke scenarios, it was hoped that some of the disadvantages of Kar2ouche could be addressed.

In collaboration with a research assistant/PhD student from the Heriot-Watt University computer sciences department a new bespoke version was created including 12 of the original 22 scenarios. The advantages and disadvantages of the scenarios and using Kar2ouche for the purposes of the research were discussed with the software developer.

These scenarios were created using Java Script web-based programming language. This programming language was chosen as it has a number of advantages such as being a simple way to create animations in a flexible way, as the developer has much more control over the code in comparison to other coding languages for animation. It also allows time control in the animation of scenes which responds well to story stem changes in animation based on the users input. Finally, another useful feature over other animation software was the ability to insert any objects from the internet which gave flexibility to create scenes that matched the narratives from the Kar2ouche version.

The strengths and limitations will be explored further in the discussion section of this chapter. For now, I will discuss the key difference of each version:

The interface and means of interacting with each narrative is quite different by comparison. Firstly, the Java Script version relies on an internet connection to work. Once connected a menu of embedded html links lead to each scenario (see figure 7.3). In Kar2ouche each scenario could be accessed through its own application saved to a desktop folder without the need to access the internet (see figures 7.1 & 7.2). As the narrative progressed in the Java Script version the children were asked the first question in an ‘if then’ statement (Yes or no: see figure 7.4) which changed the outcome of the next scene depending on the option chosen. This reduced the amount of typing required by the children. For the final part of each scenario children were required to type their “understanding” statement into a text box (see figure 7.5). In the Kar2ouche version children were required to type in the speech bubbles for their character throughout each stage of each scenario. Another difference is that the Java Script version allowed some animation/movement of the characters as part of the narrative, whereas, in Kar2ouche

each scene was made up of motionless images and more scenes were created to give the feeling of the narrative moving along.

7.2: The present study

After the final Java Script scenarios were created a pilot study was carried out to compare and evaluated the two versions on primary school children. The aim of this research study is to determine if there is a quantitative difference in the children's performance across the two task modes. The advantages and disadvantages of the software programs will also be investigated from both the children's perspective and from a research perspective. This will be in the form of descriptive responses from the children, on what they liked and did not like about each software programs, and the advantages and disadvantages of my experience of using the software for research purposes. It is expected that this information will be useful for future research collaborations between psychologists and computer scientists who wish to improve on the software used in this thesis.

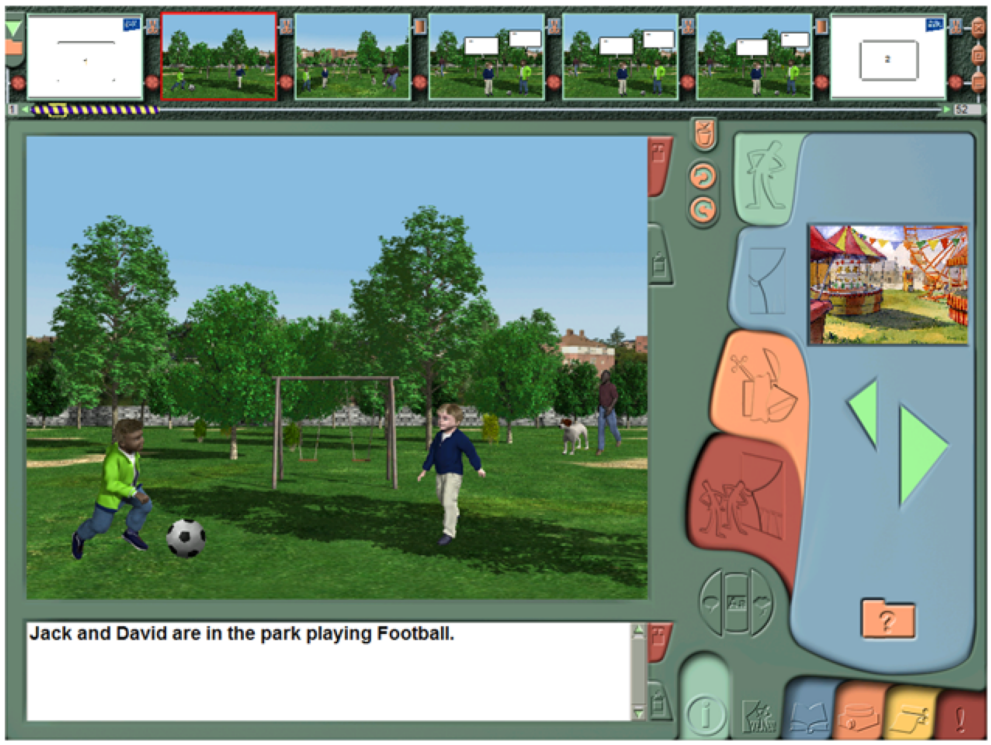


Figure 7.1: Offline Kar2ouche as viewed by the child participants

Figure 7.2: Full Kar2ouche scenario to match Java Script version

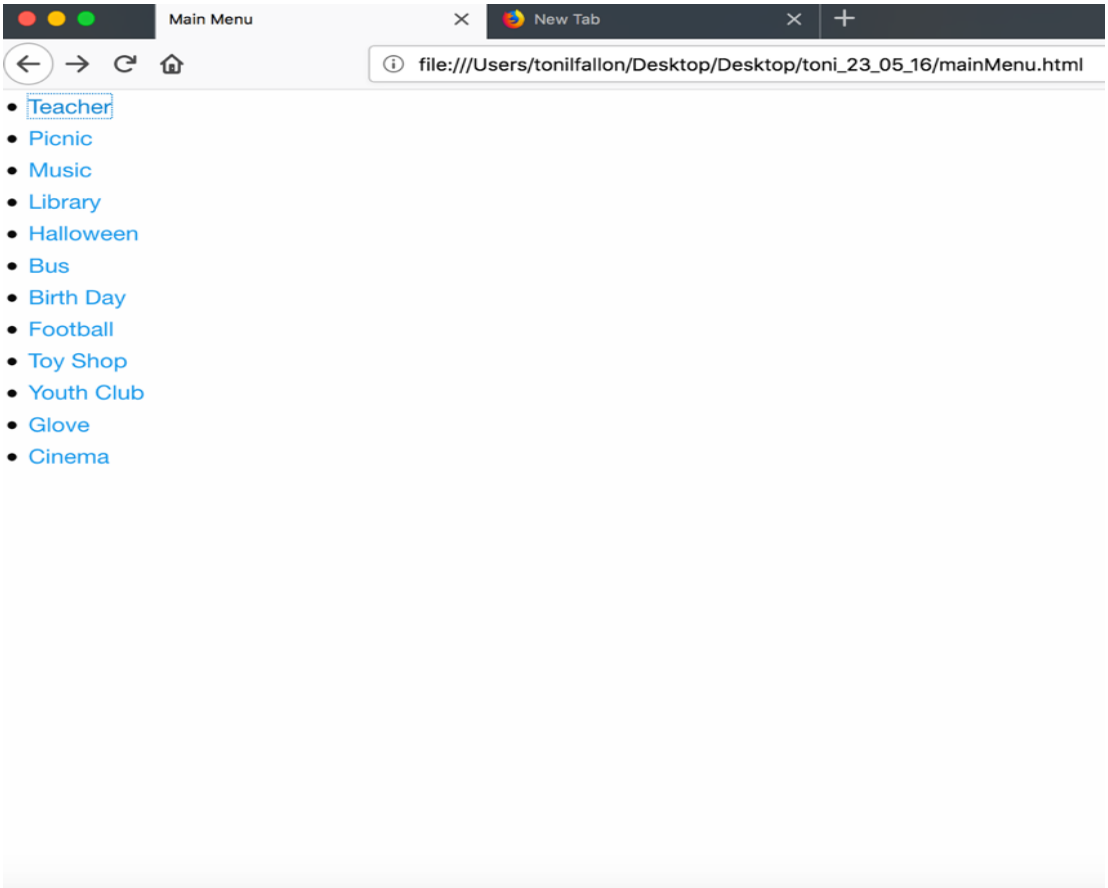


Figure 7.3: html links to each scenario in Java Script

Figure 7.4: 'Yes or No' response scene Java Script

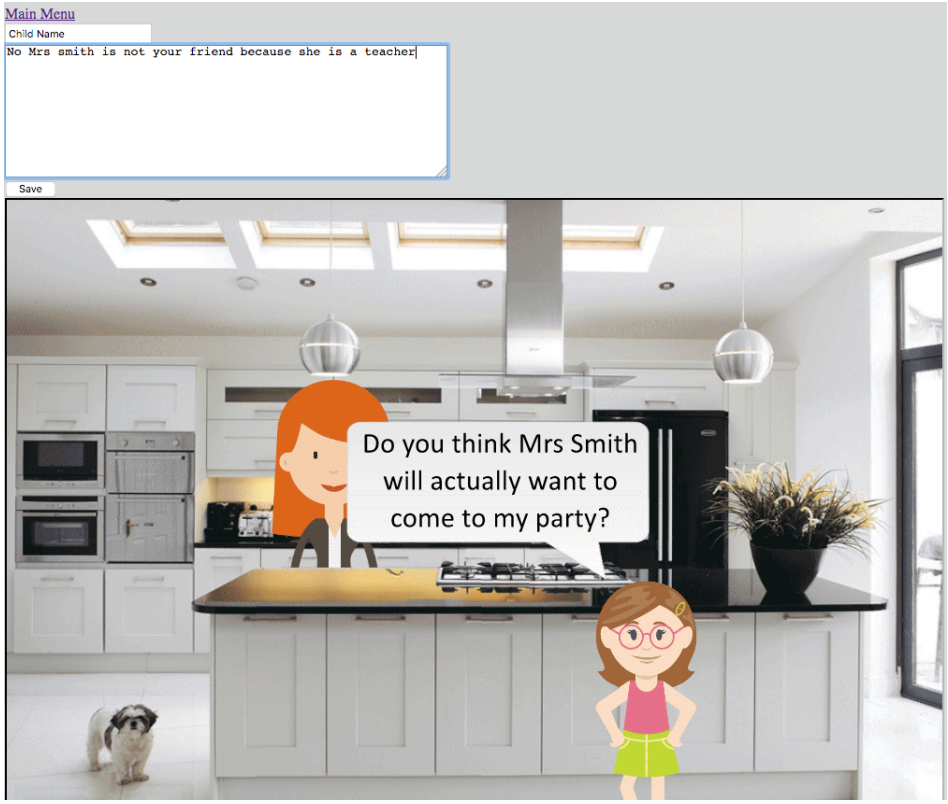


Figure 7.5: "Understanding" statement Java Script textbox

7.3: Method

7.3.1: Participants & Design

10 of the 53 children who took part in the research study from the previous chapter also took part in this pilot in the same session as the tasks reported in the previous chapter. There were 6 males and 4 females in this sample with an age range of 6.11- 8.8 years and months, mean age 7.2 SD .96. years and months. An N of 10 children completed 6 scenarios from the Java Script version and 11 scenarios from the Kar2ouche version. Only 6 theme matched scenarios from Kar2ouche were used for the purposes of this pilot. 12 scenarios were used in total (6+6 theme matched scenarios) these were counter balanced across participants. A between groups design was employed to compare performance on both versions of the scenarios.

7.3.2: Materials & Procedure

Each child completed 6 computer mediated role-play scenarios using Kar2ouche. These were employed in the same way as previous empirical chapters. The children also completed a web-based Java Script version. There was no open internet access for guests available in any of the primary schools visited. I used the 4G network from my mobile phone to connect the testing laptop to the internet in order to run the scenarios created in Java Script. This version worked best using the Firefox web browser on an Apple Mac laptop. I directed the children to each of the scenarios individually from a main menu in the web browser. The original intention was to allow the children to complete each scenario alone, although, much of the narrative and speech bubbles of characters appeared and disappeared too quickly for the children, therefore, it was necessary that I intervened during all scenarios to ensure the children's understanding of the narratives were equal to that of the Kar2ouche version. For the first part of each scenario children were given a Yes/No option button to press and for the second part they were required to type into a textbox at the top of the web page.

Once both versions of the scenarios were completed each child was asked what they thought about each version. Where children struggled I asked them if they could tell me which version they liked best and why. I then asked what they did not like about each version. All children's comments were written down in a notepad at the time.

7.4: Results

7.4.1: Test of differences on serious games

An independent sample t-test was conducted to compare performance on the Java Script and Kar2ouche version. There was no statistically significant difference of the children's scores for the Java Script (Mean 2.40 SD 2.01) and Kar2ouche (Mean 3.00 SD 2.75) versions t (18) = -.557, p = .584.

Performance did not significantly differ on the scenarios between the two different versions of software.

7.4.2: Indicative responses from child participants

After participation children were asked what they thought about each version of the game. Some children stated that they liked both, 8 out of the 10 children specified that they preferred Kar2ouche. 6 of these children explained that they enjoyed playing the character through typing in the speech bubbles arguably demonstrating some evidence of enjoying the feelings of social and self-presence enabled through role-playing a character via the speech bubbles. For example:

Participant 3: 'I like using the speech bubbles.'

Participant 7: '…pretending to be one of the characters was more fun.'

Participant 5: 'It was good to play the children and the mum in those games [Kar2ouche scenarios].'

Some of these 6 children along with the other 3 also commented that they found Kar2ouch easier to understand, found it aesthetically pleasing and more enjoyable. For example:

Participant 2: '…it was easier to know what the story was about'

Participant 5: '…I liked all the colours and different characters.'

Participant 4: 'The second game [Kar2ouche] was better.'

Participant 1: 'I could understand that one [Kar2ouche] better.'

Two children commented that they favoured the Java Script version due to the animated characters for example:

Participant 10: 'I liked the moving people, like the man who gave the boy his glove back.

The majority of children commented that the Java Script version ran too fast and it was difficult for them to keep up with the story. For example:

Participant 4: ‘I couldn’t read all the words in the first game [Java Script scenarios] it was a bit fast for me.’

Participant 7: ‘That one [Kar2ouche] was better, the stories were longer and not too fast to read’

Participant 9: ‘Those [Java Script scenarios] were too fast to read properly’

Table 7.1: Frequency of Indicative Responses

	Frequency of Positive Comments	**Frequency of Negative Comments**
Kar2uche	8/10	2/10
JavaScript	4/10	8/10

7.5: Discussion

The results of this pilot study revealed that the children’s performance on the bespoke Java Script version of the scenarios did not statistically differ from the Kar2ouche version. This means that the Java script version has the potential to measure similar behaviours to the Kar2ouche version. This makes theoretical sense because the software developer used the same narrative and very similar scenarios to the Kar2ouche version.

The bespoke web-based Java script version of the scenarios has some clear advantages, for example some of the scenarios had a more contemporary feel as they were created with modern backgrounds (rather than classic fairy tale objects that that are provided within the Kar2ouche software) and included animated characters which was enjoyable for some of the children and gave them a visual representation of the scenario narrative. As this element was not consistent across all scenarios. It would be important for future research to improve this inconsistency.

The scenarios unfolded automatically with the press of a ‘next button’ or ‘if then’ input from the child. With some small changes to the timing and presentation speed of each scene and speech bubble presentation there is potential for this version to work well without the hands-on input from the researcher. This has implications for the children’s responses as they may be more honest and truer to real life if they do not feel they are being ‘tested or ‘watched’ by the researcher. For larger studies this would enable the researcher to test multiple children at once.

Less typing is required for this version, meaning there is less pressure on children who struggle with this skill. In comparison to Kar2ouche the Java Script version is easier to use on multiple computers as no software licence is needed, and the data of the children's responses is saved to a separate output file, making it easier for researcher teams and multiple raters to access the data in a more time efficient manner. Indeed, the output files take up less storage memory making it easier to save and email files across multiple platforms. Finally, by removing the need to have the researcher taking part, with minor coding adjustments the bespoke version has the potential to increase standardisation across researchers because the computer program is narrating rather than individual researchers (Minnis et al., 2006).

There were a number of issues and errors with the coding of the bespoke Java script version. After participation each child was asked their opinion on both versions. The descriptive summary of the children's responses reveals that this was obvious to them and affected their enjoyment of the scenarios. For example, the speech bubbles contained information that was crucial to understanding the scenario, however these were not timed well by the developer, leading the speech bubble to disappear too quickly. This would allow children more control over the flow of the narrative from one scene to the next would much improve the usability and the children's understanding of each scenario.

The Java Script language did not seem to allow for direct role-playing of characters and is essentially an animated cartoon. The children's responses were not created in speech bubbles, therefore, making it more difficult for them to interact from a first-person perspective. The results of the statistical analysis revealed that this did not appear to affect the children's scores, however the children noted that they found the role-play aspect more enjoyable. Also, the first-person perspective can potentially remove the children feeling of responsibility, therefore, this could have had an effect on the results over a larger number of participants. In this pilot study I was there to remind the children that they should pretend that they are the character, which could have led to the results being similar to Kar2ouche where they otherwise might not have been. Improving the scenarios to include a role-play element and removing the reliance on the researcher's input could achieve an increase in feelings of social and self-presence which is important for an effective true to life social response in gaming (Tamborini & Skalski, 2006).

There was less narrative at the beginning of each scenario, the only narrative was contained within the speech bubbles. This means that the children did not get the same "back" story as they did in the Kar2ouche version. It was observed that the children

mentioned that they enjoyed having the story read to them rather than reading the speech bubbles themselves. It would be useful for a future update to include a voice over of the narrative and speech bubble discussions for the children to listen to. This is particularly important considering research demonstrations that children have better auditory and auditory-visual memory skills in comparison to visual or verbal memory skills (Pillai & Yathiraj, 2017). Scenarios which solely rely on the child's reading ability may not yield a rich source of the children's understanding of the social scenarios. I read the narrative aloud to all children (which would have been advantageous to their memory skill set), although, I would suggest that future research included headphones for children to hear the narrative. This combined with removing the researcher's input could be another potential avenue for increasing feeling of psychological presence (Slater and Wilbur 1997).

Another issue was the reliance on an internet connection: whereas this had advantages of allowing the scenarios to play out in real time, this was disadvantageous when conducting field research, particularly in environments such as rural schools who do not have the facility to provide guests with wireless internet access and sometimes do not have a reliable 4G coverage in particular areas, however, this is unlikely to be an issue for much longer as broadband access continues to improve.

A final limitation of this study was that the research may have benefited from a qualitative analysis of the children's responses, however, this was not possible due to the children's responses being too short to extract suitable themes for a qualitative analysis. Arguably, given the aims of this chapter descriptive information was sufficient. Carrying out a qualitative analysis on themes (as is common in some psychological research fields) is not common practice in the academic field of interaction design and the user experience, and typically, descriptive information from the target users of the product is sufficient.

As well as improving on some of the limitations mentioned here future research should explore the idea of increasing psychological presence which could have the potential to further increase levels of immersion in the role-play scenarios (Slater & Wilbur 1997).

Further exploring the "spectrum" of immersion in child populations would be useful because they may respond differently adult the participants that currently dominate this field of research. For example, study 1 used a "paper pencil" task with a picture for

each story. The children answered questions from a 3rd person perspective, next I increased psychological presence by having children role-play characters from a first-person perspective. Another idea would be to create the scenarios in a 3D gaming platform or create a programme for a virtual reality head set (See Figure 7.5).

This pilot study aimed to further the usability for both participants and researchers, and to increase the feeling of psychological "presence" by building a bespoke task in a Java Script web animation program. Removing the reliance of the researcher's input was not possible due to the limitations of the software. This is something future research could explore in more depth.

The bespoke version of the scenarios appears to have many useful advantages for research into IF/DSED and social vulnerability, however, a revised version is necessary before further research can be carried out. A summary of the key advantages and disadvantages can be found in table 7.1 .

Figure 7.6: A "spectrum" of Immersion

Table 7.2: Evaluation of both computer versions of the IF/DSE scenarios.

Kar2ouche (Used chapter 3-7)		**Java Script (Bespoke version chapter 7)**	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
Allows the mechanism of computer role-play (responses in speech bubbles)	A lot of typing required	Less typing required	Mechanism of role-play needs improvement
Scenarios can be easily and quickly changed by computer novice.	Fixed number of characters and objects to create scenarios.	Choose any characters and objects from the internet.	Knowledge of Java script programming language required to create and alter scenarios.
No data output file.	Non-animated characters	Animated characters	No sound – characters don't speak
Timings controlled by the child	No sound- characters don't speak	Easier and quicker to access scenarios data output file	Timings of animations/scenes too fast.
Background narrative read by researcher	Out of date technology making it slower to load	Has potential to remove reliance on the researcher to take part. E.g. scenes can unfold automatically.	Less background narrative. (Potential is there to add this).
A child friendly application.	Software licence needed. Scenarios difficult to access without this.	Potential to test more than one child in same session.	No speech bubbles for child's response.
No internet connection required to run scenarios.		Scenarios can be quickly emailed to colleagues.	

Chapter 8: General Discussion

8.1: Introduction

This penultimate chapter will provide a full discussion of the research findings and implications of this thesis. Firstly, I will summarise the findings of each empirical chapter (Chapters 3-7). Secondly, the theoretical implications of the findings will be discussed. Thirdly, I will outline the limitations of the empirical research and recommendations for future research. Fourthly, I will utilise the findings of the present research to make recommendations for interventions that could be applied by researchers, clinicians and other practitioners. Finally, I will highlight the applied impact of this thesis and its relevance to global and local government policy.

8.2: Chapter 3: Paper and Pencil V's Computer Mediated Role-play

In chapter 3 of this thesis I outline the findings of the first empirical research study. First, the findings revealed the developmental age difference of social vulnerability/IF, with 10 and 8-year-old showing significantly fewer disinhibited behaviours than 6-year olds. Second, this age differentiation was greater in the computer mediated role-play version of the task. These findings support the hypothesis that children will exhibit more DSE/IF behaviours in the computer role-play than the paper and pencil version of the task. Third, the prediction that there would be a negative relationship between DSE and ToM was also supported, which is particularly important to finding initial validation of the computer mediated role-play measure.

This is the first study to successfully quantify DSE and social vulnerability in middle childhood and is the first to investigate the development of DSE and social vulnerability in the typical population of children.

The success of the computer role-play scenarios resulted in these being utilised for all subsequent empirical studies in this thesis. This method seems to be especially valuable for children in the middle childhood range of around age 5 – 9 years old, because there was no significant difference in the scores of paper-pencil and role-play task version for the older children in this study. This may because by the end of middle childhood/primary school years, typically developing children have largely mastered basic awareness of social safety.

8.3: Chapter 4: The role of ToM, Inhibitory Control, and Cognitive Flexibility

In chapter 4 I aimed to further explore evidence of the link between ToM and the computer-mediated role-play scenarios. A surge of literature in the last decade indicates a relationship between EF and social understanding (Lewis & Carpendale 2009; Carlson 2009), and ToM ability (Flynn, O'Malley, & Wood, 2004; Frye et al., 1995; Hughes, 1998; Moses, 2005; Pellicano, 2007; Perner & Lang, 2000; Moriguchi, 2014; Bock, Galloway & Hund 2015).

Inhibitory control and cognitive flexibility were also explored in relation to the computer mediated role-play scenarios, these results strongly confirm the relationship between ToM and social vulnerability/ IF as measure by the computer mediated role-play task. The findings demonstrate that ToM is a predictive factor. Having good ToM abilities appears to be an important protective factor in children who demonstrated good social understanding and navigated the role-play scenarios in a way that would help them to stay safe if they were in real-life situations. Thus, this finding is strongly supported by and adds a new dimension to literature discussed in the previous chapter which demonstrate that ToM predicts multiple aspects of children's social skills and competencies (e.g. Huges & Leekam 2004).

Correlational results demonstrate a significant relationship between cognitive flexibility and social vulnerability, which is supported by a number of previous studies who found evidence of a relationship between social interaction skills and EF (Carlson & Moses, 2001; Moses & Tahiroglu, 2010; Sabbagh et al., 2006). None of the measures of EF employed in this research were significant predictors of social vulnerability/ indiscriminate friendliness which is contrary to the findings from Bock et al., (2009) who suggested that EF predicts social understanding. Thus, this finding arguably adds to the literature that suggests EF may be necessary in influencing social interaction skills, but EF is not the main mediating factor (Sabbagh et al., 2006; Miller 2009).

There was also a correlation with age, but again, age was not a predictive factor, this may be due to the children being quite close in age, individual differences and/or the simplicity of the role-play game may have been a factor. IQ as measured by the WASI was also a non-significant predictor, thus, it can be argued that poor intelligence and/or general cognitive ability is not a contributing factor in children who display indiscriminate and socially vulnerable behaviours in this research.

Thus, the main finding here is that poor ToM ability is a predictor of social vulnerability. This confirms that having a good ToM understanding is likely to be a

protective factor for IF and general social vulnerability. This means that improving ToM abilities could help to keep vulnerable groups of children safer, particularly in social situations with peers and adults out with the family environment.

8.4: Chapter 5: Exploring social vulnerabilities and IF through computer mediated role-play in Looked After Children

In chapter 5 I compared a LAC group with low risk children who had not been in care on a number of cognitive measures employed in chapter 3.

The findings revealed that the LAC group show significantly higher performance on the computer mediated role-play scenarios which measure IF/DSE through scenarios which reveal levels of social vulnerability. Thus, these results suggest that the LAC children do have increased levels of IF behaviours and are at risk of being socially vulnerable, as measured by these scenarios in comparison to the LRC group. Study 3 demonstrates that it is possible to differentiate between LAC and LRC children using the computer mediated role-play scenarios.

The LAC group also revealed a significantly poorer performance on the Strange Stories, meaning that their ToM understanding was poorer than the LRC group. Despite the sample size being relatively small, this finding is consistent with much previous research (Cicchetti et al, 2003; Covert et al., 2008; Kay & Green 2016; Pears & Fisher 2005), this suggests that LA children may have poorer competency in understanding the intentions of others within the context of social interactions.

Measuring ToM through a verbal measure such as the ‘strange stories’ is problematic with this group of children because confounds with language have been highlighted in previous research (de Villiers, 2007; Kay & Green 2016), although, steps were taken in the present research to control for abilities through IQ matching with the LRC. Nevertheless, other findings demonstrate that adolescents who have been in the care system may have poorer metalizing abilities (in a truer to real life friendship interview settings) than matched controls even when controlling for language (Kay & Green 2016). Here, group differences were also found with the RPQ teacher and parent versions and with disinhibited sub-items where the LAC group were reported as scoring significantly higher than the LRC group. No diagnostic claims can be made, but this nevertheless confirms the presence of DSED/IF behaviours within the LAC sample, which is supported by much previous research (e.g. Miellet et al., 2014).

In line with chapter 4 the hypothesis that the groups would significantly differ on measures of inhibitory control via the Go/No-Go and Stroop test were not supported,

which is contrary to much previous research (Bruce et al., 2009; Gorter et al., 2017). There was no relationship in the overall sample between the computer mediated role-play scenarios when compared with the Go/No-Go and Stroop test, but when the data from both groups was separated, a significant relationship was found between Stroop errors and performances on the computer mediated role-play scenarios in the LAC group. This provides some support to previous findings that inhibitory control is an issue for children suffering from DSED/IF behaviours (Bruce et al., 2009; Gorter et al., 2017).

The findings in this chapter also revealed a significant negative relationship with performance on the computer mediated role-play scenarios and the Strange Stories, for both LA children and LR children. This is only correlational in nature, but nevertheless supports the finding in the previous chapter than ToM predicts socially vulnerable IF behaviours as measured by the computer mediated role-play task.

Significant relationships with the RPQs and the computer mediated role-play scenarios also further supports previous data presented earlier in this thesis that the role-play scenarios measure aspects of DSE/IF to some extent. So, previous research does support these aspects of DSED are noted by researchers such as Olsavsky, et al., (2013) who suggested that in more real-life settings, a lack of discrimination in response to strangers was associated with parent reports of IF. My role-play scenarios aimed to capture this with scenarios that involved interactions with strangers after a parent has warned the child not to speak to any strangers. The children in the LA group in the present study were less likely to consider the parents instruction and more likely to agree to the interaction with the stranger and were not as able to articulate the reasons why this may be an issue as well as the LRC group, even when they expressed a hunch that their initial decision to agree may have been wrong.

This was not originally a hypothesis, but the results give further support for the behaviours measured in the computer mediated role-play scenarios. This is because they revealed no statistically significant relationship between ToM and the RPQs which supports previous research (Kay & Green 2016). Thus, this could mean that although LA children have issues with ToM understanding this may indeed be a consequence of other aspects of being 'looked after'/ maltreatment rather than the disinhibited behaviour itself. This gives some confirmation that the role-play scenarios in this thesis measure aspects of DSED/IF that are independent of ToM ability. This provides some validation that this measure does indeed measure the social vulnerability aspects of DSE/IF, distinct from ToM measures.

This finding has also highlighted that the correlation and predictive ability between ToM and the role-play scenarios may suggest that my scenarios go beyond the RPQS in measuring DSED behaviours. The scenarios measure many real-life social situations that can be problematic to those who display DSED behaviours and highlights the real-life impact of those with symptoms of DSE/IF. The social issues may be intertwined with IF behaviours, such as difficulties in effective social problem solving and issues with social reciprocity when interacting with others, which I believe is also a key aspect of successfully navigating the role-play scenarios, along with having some ability to understand that another person's intentions may be different from one's own.

8.5: Chapter 6: The role of social cognition and hot EF

The finding from the previous 3 chapters that ToM is consistently related to and predicts IF/ social vulnerability in children led me to explore social cognition in more detail. This was done by obtaining class teacher ratings of each child on the SRS-2. I also explored hot EF by employing the HDT.

The results revealed that there are two key predictors of the computer mediated role-play scenarios; both the SRS-2 and children 'knowing' the advantageous doors in the HDT.

This, therefore, gives further validity to the computer mediated role-play scenarios, as effective in measuring social aspects of children's behaviour.

Children who scored high on the SRS-2 also scored high on the computer mediated role-play scenarios and vice versa. Class teacher observations of the children's in class social behaviour were reflected in their ability to navigate the role-play scenarios. Demonstrating that social awareness, social cognition, social communication and social motivation as measured by the SRS-2 appear to be protective factors for children in real life situations where they could potentially become socially vulnerable. This finding is supported by previous research which demonstrates that teacher ratings on the SRS-2 are related to children's abilities on social stories (Marshall et al., 2016).

The findings also demonstrate that children who could identify the advantageous doors when questioned by the researcher during the HDT were better at successfully navigating the computer mediated role-play scenarios in a way that lead to safer outcomes, however, the total behavioural scores on the HDT were not predictive of IF/social vulnerability.

Thus, on a qualitative level many of these children still understood that they were making a poor choice. I saw that children who learned they were selecting the disadvantageous doors would move onto the advantageous doors after experiencing the emotions of a large net loss. Despite this, after selecting the advantageous doors for a while, these children could not resist another go at making a larger gain and would go back to the disadvantageous doors despite knowing the risk. Indeed, children in this age group (6-8 years old) are especially poor at selecting the advantageous doors (Crone et al.,2004; Crone & van der Molen, 2004; Crone & van der Molen, 2007; Hooper, Luciana, Conklin, & Yarger, 2004; Overman, 2004). Indeed, the present data supports this as the mean scores reveal that the majority of children in this study made a net loss, meaning that they were more likely to choose the disadvantageous doors. As with high stakes gambling it appears that children in this age group are enticed by the greater up-front rewards and have a ‘‘myopia for the future’’ (Crone et al., 2004; Crone & van der Molen, 2004; Hooper, et al., 2004; Overman, 2004) despite understanding the potential risk.

This is supported by classic Piagetian theory which states that many children under 9 years old fail to utilise the knowledge they have (Piaget, 1972). This could be due to children at this age having poorer self-regulation, and control of their own cognition. Indeed, tasks such as the Hungry Donkey require intentionality which Russell (1996) describes as the precursor of self-awareness and metacognitive processing. This is related to developing a grasp of agency, mental state concepts and tests the ability to handle embedded rules. This means that, although, the children have an awareness of the rules, they cannot yet apply an intentional strategy. This can be confirmed by Vygotsky (1962) who argued that deliberate mastery is still developing at this stage of childhood. This suggests that the earlier argument in this thesis that children under 9 years old understand right from wrong when questioned by an adult, but do not always have the ability to behave in a way that reflects this understanding of risk in real life situations.

8.6: Chapter 7: Recommendations for technology advancements

The final research chapter of this thesis aimed to create a bespoke version of the computer mediated role-play scenarios that would improve the scenarios for both the child participants and the researcher. The empirical research in study 1 highlighted that the colourful step by step pictures of the scenarios were useful in helping the children’s engagement and understanding over the “paper and pencil” version, therefore, it seems

important to further improve this for research use. Indeed, this is supported by Sivaratnam et al., (2012) who found colourful comic strips useful as an alternative to vignettes.

Once the new scenarios were developed a pilot study was conducted. This chapter aimed to further the usability for both participants and researchers, and to increase the feeling of psychological "presence" by building a bespoke task in a Java Script web animation program.

The findings of this pilot study revealed that the children's performance on the bespoke Java Script version of the scenarios did not statistically differ from the Kar2ouche version. This means that the Java Script version has the potential to measure similar behaviours to the Kar2ouche version. This makes theoretical sense because the software developer used the same narrative and very similar scenarios to the Kar2ouche version.

There were a number of advantages and disadvantages to this version in comparison to Kar2ouche. For example, some of the scenarios had a more contemporary feel as they were created with modern backgrounds (rather than classic fairy tale objects that that are provided within the Kar2ouche software) and included animated characters which was enjoyable for some of the children and gave them a visual representation of the scenario narrative. A key limitation was that this version lost the mechanism of role-play and the scenarios could not be changed or adapted with ease. Removing the reliance on the researcher was not possible due to the limitations of the software. This is something future research could explore in more depth.

As well as improving on some of the limitations mentioned here future research should explore the idea of increasing psychological presence which could have the potential to further increase levels of immersion in the role-play scenarios (Slater & Wilbur 1997).

Further exploring the "spectrum" of immersion in child populations would be useful because they may respond differently to adult's participants that currently dominate this field of research. For example, study 1 used a "paper pencil" task with a picture for each story, the children answered questions from a 3rd person perspective, next we increased psychological presence by having children role-play characters from a first-person perspective.

Another idea would be to create the scenarios in a 3D gaming platform or a programme for a virtual reality head set. For example, Didehbani et al., (2016) carried

out a pilot study investigating social cognition training in virtual reality for children with high functioning autism. They confirmed that virtual reality was a feasible method for improving emotion recognition, social attribution, attention and EF in their sample. Another possibility is the use of augmented reality to improve children's social skills. For example, this has been done to some extent where augmented videos were used to improve the judgments of others facial cues and emotions in children with ASD, who typically have difficulties in distinguishing the nonverbal cues of others (Chen, Lee & Lin, 2016). Considering the similarities, the scenarios developed in this thesis could also work well in a virtual reality or augmented reality setting.

8.7: Overall theoretical and applied implications of findings

A key theme in the findings of this thesis was the importance of social cognition. More specifically ToM ability in chapters 3-5 was significantly related to IF/social vulnerability in children. The more robust analysis in chapter 4 revealed that this is a key predictor variable, meaning that children with poor ToM abilities are more likely to display signs of social vulnerability and IF behaviours. This was also supported by findings in chapter 6 which demonstrated a similar pattern of results on a more general measure of social cognition the SRS-2.

The findings revealed that poor ToM ability and poor social cognition in general are predictors of social vulnerability and vice versa. This confirms, that having good ToM understanding is likely to be a protective factor to IF and general social vulnerability. This means that improving ToM and general social cognitive abilities could help to keep vulnerable groups of children safer, particularly in social situations with peers and adults out with immediate family.

This result supports previous research which links ToM ability to aspects of social understanding (Astington & Jenkins 1995; Astington 2001; Bosacki & Astington 2001; Carpendale & Lewis 2004) and issues related to ToM deficits and social understanding in vulnerable groups of children (Cicchetti et al, 2003; Covert et al., 2008; Luke & Banergee, 2012; Kay & Green 2016; Pears & Fisher 2005). These findings also extend the current sphere of applicability of ToM research on children's social understanding as I have demonstrated that this can apply to vulnerable children's social safety in 'real-world' situations.

In general, the findings of this thesis confirm the previous evidence that argues for the positive role that computer games can have for children (e.g. Durkin 2010). The

research confirms the overall usefulness of serious games and in particular the mechanism of computer mediated role-paly is helpful for all children and not just those with ASD (e.g. Aylet et al., 2004; Minnis et al., 2010; Robertson & Oberkander, 2002). This research has extended the scope of serious games for children to the area of IF/DSE and social vulnerability.

The majority of previous research in this field focusses on serious games as tools for intervention (Fletcher-Watson & Durkin 2014; Kandalaft et al., 2013; Parsons, et al., 2005; Wallace, et al., 2010). This thesis demonstrates the value of computer mediated role-play, which extends serious gaming's current sphere of research activity into the field of children's psycho-social measurement.

My findings support previous research that suggests using role-play measures children's working understanding in comparison to vignettes that rely on a more reflective understanding (Rajendran & Mitchell, 2000; Rajendran et al., 2005). Arguably the younger children performed in a way that is closer to their real-life behaviours in the role-play task because this allowed the child to simulate or "walk in the shoes" of the character and make real decisions in a simulation type way (e.g. Harris, 1992), rather than deciding on what the characters might do in a hypothetical situation that is created using social vignettes, where a child might feel under pressure to give the correct or most appropriate answer (Seigal, 2004), or have to work the correct answer out in more abstract or 'theory theory' type way (e.g. Chapman, 1988).

Thus, from a theoretical perspective, the findings support a simulation theory account of the development of ToM in middle childhood (Harris, 1992). This is important because it suggests that children's "real-world" behaviour is more likely to be measured accurately from a first person (e.g. role-play), rather than a third person (Paper pencil) perspective. This arguably supports the concept of presence (e.g. Slater 1997), in which responses in the computer role-play task version are more like the responses that participants might give in real life. Another explanation may be that higher levels of disinhibited behaviour in a computer role-play task were due to the perceived safety of the environment. I suggest though that this is unlikely because in the studies where only typically developing children were recruited the findings indicate that most participants in the youngest age group (6-year-olds) achieved approximately only a quarter of the potential total disinhibited score available. This means that disinhibited and vulnerable behaviours are relatively low (as to be expected in this population), so there is plenty of

"room" in the assessment to measure atypical behaviour. Certainly, chapter 5 highlights that the LA children had a significantly higher overall score.

Importantly, this thesis represents a revival and advancement in the literature concerning measuring social aspects of behaviour through computer mediated role-play. The work was largely inspired by the work of Rajendran and Mitchell, (2000), and Rajendran, Mitchell and Richards, (2015). From a technological perspective the Kar2ouche is a more advanced and aesthetically pleasing colourful software (in comparison to Bubble Dialogue used in previous research) that appeals directly to children, due to its original purpose as a children's story telling software. As well as this the scenarios presented to the children in this chapter also maintained the original advantages of the mechanism of computer mediated role-play that arguably gives a clearer representation of events from the perspective of the child (Jones et al., 1988).

8.8: Limitations and recommendations for future research

There were a number of challenges to gaining access to vulnerable children in Scotland. These issues were in part due to the complex legalities of whom should give consent for the child to participate in research. In the cases of the most vulnerable children the legal guardian of the child is their social worker. In the majority of cases it was deemed by the child's legal guardian that they were too vulnerable and had been through too much trauma to take part in research.

In this research and in the literature in general, there are many gaps in reporting the potentially predictive variables. It is plain to see for those in the research area that this is not merely an oversight or bias in reporting, but access to samples of LAC and similar groups is necessarily difficult; their vulnerable status means that negotiations must be made with a number of gatekeepers (with other priorities) in order to collect data. This means that in practice research such as the present study are only able to gain sample sizes that are often too small for researchers to sub-categorise children according to differences or interactions in some variables. This practical aspect of the research goes some way to explaining the tendency to report only an overall effect in studies with smaller samples, which means the heterogeneity in the sample here and in other research is not always obvious. In this field of research it is difficult to establish accurate and reliable behavioural data that can accommodate the individual differences of vulnerable children. Thus, behavioural data on this group of children in Scotland remains limited.

Even with the opportunity of access to larger samples, researchers need to come to a decision about which of the many potentially influential social, cognitive, environmental etc. differences between individuals might be worth examining so not to overly burden the sample. With these large samples being in short supply there is still much to learn about IF behaviour in LA children.

Recent research (Woods et al., 2018) carried out by the Children's Reporter Administration in Scotland has highlighted that the legislative and professional practices in place to protect LA children in Scotland have become too complex. These have increased levels of difficulty in lives of vulnerable children and their families both directly through their involvement in legal processes and indirectly through increased family division as a result of interventions to take children into care. As well as this current complex legal system can cause a lot of stress for the families involved, and thus increasing the psychological and behavioural issues of the children involved (Woods et al., 2018). This has also added complexity to the work of researchers and other related agencies who wish to support vulnerable children, meaning that vital support is not reaching the most vulnerable children and researchers lack a complete understanding of the most effective methods for intervention. The recent acknowledgment from the Children's Reporter will hopefully lead to a wider appreciation for the benefits of psychological research and intervention and perhaps encourage more research activity in the future. Nevertheless, findings of the LA children research in this thesis demonstrate that this is a fruitful and worthwhile research area and warrants future investigations into the usefulness of using computer mediated role-play to investigate IF and social safety in vulnerable children.

Contrary to previous research, I did not find much evidence to support the role of poor EF in DSE/IF behaviours. Previous work on DSED and IF gave a largely cognitive explanation for these behaviours in particular demonstrating impairments of inhibitory control (Bruce et al 2009; Gorter et al., 2017). A correlation was found in study 2 between the computer mediated role-play task and cognitive flexibility as measured by the DCCS, although, these were not confirmed in study 4. Research from study 3 suggests that the cognitive impairments may only be present in the most vulnerable children, therefore, further research should explore social vulnerability in these groups of children with a different battery of cognitive tests to help disentangle this link in more detail. In particular further exploration the role of hot EF and emotional understanding would be useful to this research area (Luke & Banerjee 2012; Pears & Fisher 2005).

Great lengths were taken to measure IF through the computer mediated role-play scenarios, although, there are likely to be elements of IF that this measure does not capture. For example, observational research is useful for picking up on non-verbal signs of IF such as the child's body language when interacting with others e.g. touching strangers (Lawler et al., 2014). It appears that the measure is more suited to being described as a measure of social vulnerability that can detect aspects of IF behaviours that may lead a child to become socially vulnerable.

In this sense, the measure could equally be applied to other groups of vulnerable children such as those with a diagnosis of ASD, Williams Syndrome, Downs Syndrome or ADHD. Indeed, with the SRS-2 being a predictor variable in study 4 exploring the computer mediated role-play scenarios in future research on children with and without ASD would be worthwhile. This would be an interesting avenue for research that could create a wider understanding of similar behavioural patterns that appear in different disorders. For example, future research could demonstrate that social vulnerability can occur from both environmental (e.g. DSED through early maltreatment) and genetic (e.g. ASD and Williams Syndrome) pathways and the implications of this for interventions.

8.9: Recommendations for intervention

8.9.1: Social skills training

At present there is a tremendous focus within the research community on the use of serious games for social skills interventions in young people with ASD. As discussed in the introduction of this thesis there is overwhelming evidence to support the usefulness of using serious games as a social intervention tools to support those with ASD (e.g. Fletcher -Watson et al 2014; Hall, Woods, & Hall, 2009; Minnis et al., 2010; Porayska-Pomsta, 2012; Rajendraan et al, 2005). In comparison there is a smaller amount of serious game research focusing on social issues in other groups of children (e.g. Aylett et al., 2005, Minnis et al., 2010). The findings in this thesis support the research that suggests that children with IF and RDA may in fact benefit from social skills interventions in a similar way as those with ASD (Mukaddaes et al., 2004).

This research extends the recommended sphere of social interventions beyond that of children with ASD and highlights that these social training interventions would be equally useful for improving social competencies in all groups of children, and in particular those who have been identified as at risk of social vulnerability.

Indeed, as well as the potential to utilise the computer mediated role-play scenarios as a means for clinicians to identify social vulnerabilities in at risk children, the scenarios can be easily adapted for use as an intervention tool. This could be used in research, clinical practice, schools and support groups as a safe place for children to practice and learn how to handle a variety of social situations is a safe environment. The results of this thesis highlight that simply teaching children that others may have intentions, thoughts and feelings that are different from theirs would be a useful child protection strategy (see figure 8.1).

This intervention and assessment tool is applicable to many groups of children and extends to both developmental disorders caused by the environment e.g. RAD, DSED often seen in children who are institutionalised or in foster care due to neglect and abuse. This type of intervention is also relevant to neurodevelopmental and genetic conditions that cause impairments in social understanding e.g. ASD, Williams Syndrome and Downs Syndrome, therefore, the findings are useful to both clinical practitioners and researchers working in this field.

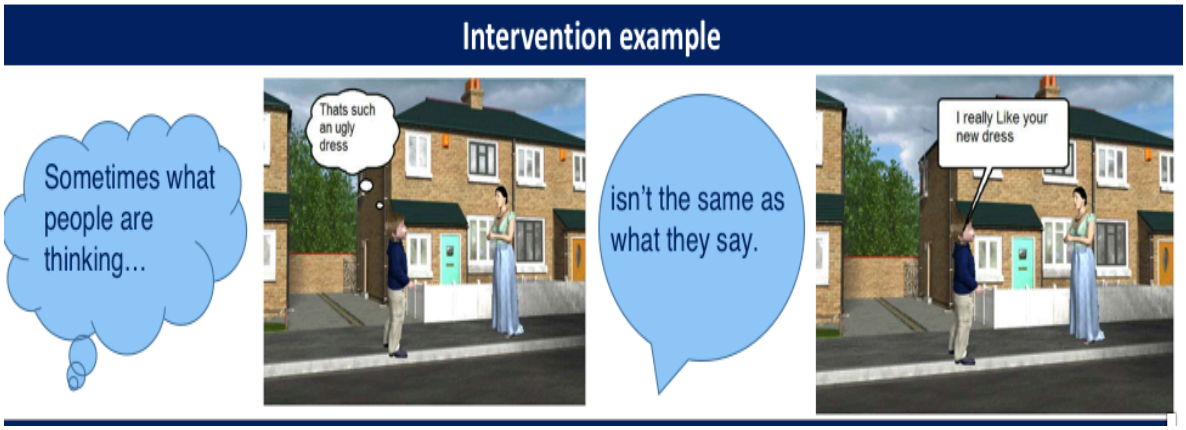


Figure 8.1: Example of computer - role-play social skills training scenario.

8.9.2: Cognitive training

The evidence from this research largely support a social cognitive understanding of the findings, although, cognitive training interventions would still be a useful addition for supporting socially vulnerable children. This thesis has provided some evidence to suggest that improvements in EF may also be useful as there was a relationship found between cognitive flexibility and the computer mediated role-play performance in chapter 4. Also, a relationship of inhibitory control (classic Stroop test) and the role-play

scenarios was discovered in the looked after children. It would also be interesting to explore cognitive intervention focussed on aspects of hot executive function. For example, the results obtained in chapter 6 highlight that training children's behavioural response to risk and reward may be useful to promoting social safety skills in at risk groups of children. For example, practicing real life situations where there are potential risks may be more useful that having children answer questions about hypothetical situations.

8.10: Applied impact of this thesis

This thesis has extended the application of psychological theory and research to the measurement IF/DE and children's social vulnerabilities by creating an ecologically valid assessment method through the computer mediated role-play scenarios. This is the first psychological research to directly measure and link IF and DSE with poor social safety skills. The finding that ToM and social cognition are predictive of social vulnerability has impact for improving the social safety of all children.

The research findings are useful in that they meet the requirements of a number of Scottish Government (SG) and global agendas on child wellbeing. Children's social vulnerability is a global issue that has been largely under researched from a psychological perspective. This issue comes under the remit of the United Nations Convention of the rights of the child 1989 (UNCRC) where it is recognised that all children have the right to health, education and protection. Indeed, the Children and Young People (Scotland) Act 2014 recognises the UNCRC and has been set up to focus on prevention and early intervention for children and their families. The national approach to applying this act in everyday settings such as schools is the Getting It Right for every Child agenda (GIRFEC). In Scotland as part of the act mentioned above local authorities are legally required to report to the Scottish Government on the overall wellbeing of their children through 8 key wellbeing indicators: Safe, Healthy, Achieving, Nurtured, Active, Respected, Responsible and Included (SHANARRI: See Figure 8.2). A key way for local authorities to do this is through taking part in research that is relevant to children's wellbeing. Local authorities have limited resources to carry out research, therefore, partnerships with academics can be very useful to gaining evidence for SHANARRI.

This thesis makes a unique contribution to promoting the wellbeing of children in Scotland and can arguably contribute to at least 7 of the 8 wellbeing indicators (e.g. Safe, Healthy, Achieving, Nurtured, Respected, Responsible & Included). In particular the

work presented here suggests that by improving the social cognitive skills of primary school aged children through intervention (for example, by practicing social situations using safe techniques such as computer mediated role-play) could improve the social safety skills of our vulnerable young people.

This thesis also emphasises that identification of poor social development is important for improving the general mental health (e.g. reducing DSE/IF behaviours) and social cognitive skills of vulnerable/ LAC during the primary school years and could ultimately help protect these individuals from social harm throughout their lifetime. At present there is limited research or data exploring the psychological (e.g. social and cognitive in particular) wellbeing of children in children in Scotland. In particular children in care are amongst the most vulnerable and have been largely ignored by research in comparison to those with neurodevelopmental disorders.

Thus, this thesis has highlighted the importance of a fruitful but relatively neglected area of research. Considering that children's social safety and well-being is a global issue the findings of this thesis should act as a call to commission more related research in this field. Due to the implications of the findings this area should be a priority for relevant charities and government funding bodies as the research is useful to a range of professionals involved in supporting children and young people.

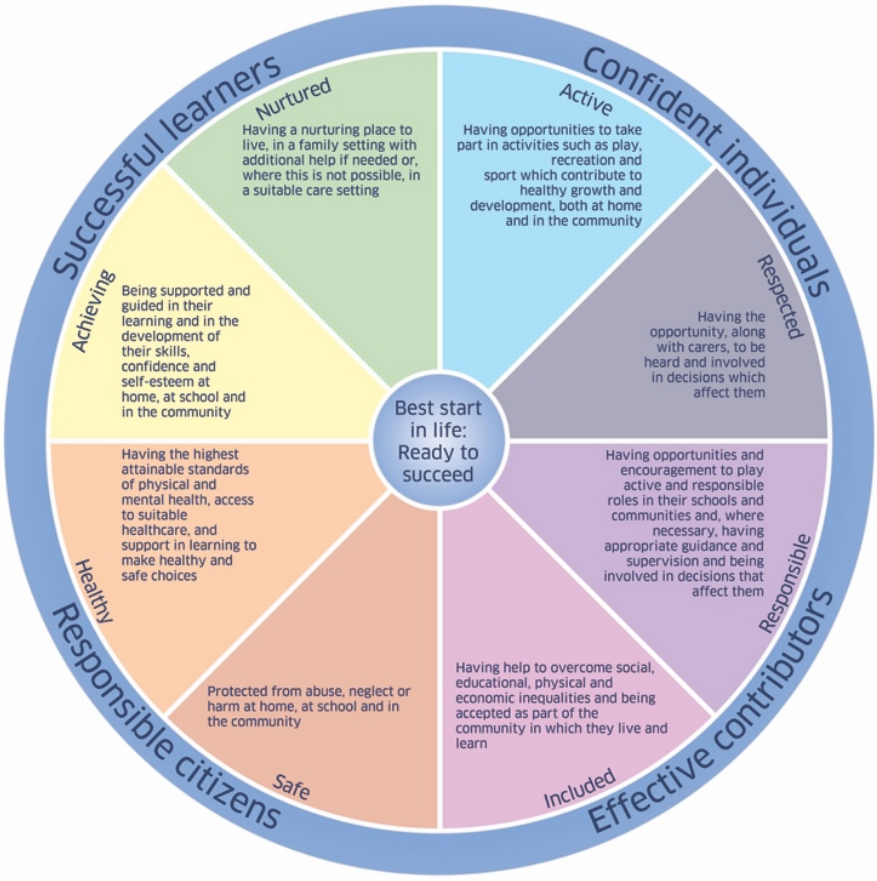


Figure 8.2: SHANARRI Wheel of Wellbeing

8.11: Conclusions

This is the first psychological research to find a robust link between children's social cognition, IF and the real-world problem of social vulnerability.

The findings reported in this thesis have highlighted the value and usefulness of computer mediated role-play for measuring IF/ social vulnerability in children, the evidence presented in this thesis supports and adds to the current literature on using technology as a behavioural measurement tool in children (e.g. Minnis et al., 2010; Rajendran et al., 2005).

The scenarios that I created have been validated in various ways throughout this thesis. The most dominant finding was the importance of social cognition, in the form of the children's responses to the 'Strange Stories' and the teacher ratings on the SRS-2. This adds to and extends previous literature which suggests that children's social thought and social understanding is linked to their social behaviours in the 'real world' (Astington 2001; Caependale & Lewis 2006; Happé & Frith 2014; Huges & Leekam 2004; Jenkins & Astington 2000; Wimmer and Perner 1983; Wellman 2018).

Developmental age discrimination of the measure was also highlighted which demonstrates that out with individual differences social safety is a skill a child develops over the primary school years. This is the first known research evidence to highlight developmental differences in social vulnerability and IF/DSE using both story vignettes and computer mediate role-play.

This is also the first known research to use the technique of computer mediated role-play to measure IF behaviours in looked after children. These findings revealed that LAC groups display statistically more DSE/IF behaviours than LRC, meaning that these children were likely to be socially vulnerable. Importantly, although role-play performance was also related to ToM, the research highlighted that DSE behaviours were independent of ToM ability in these children, which supports previous research (Kay & Green 2016). Also, the findings support previous research which suggests that LAC groups have poorer social understanding that LRC peers (Cicchetti et al., 2003; Colvert et al., 2008; Kay & Green 2016; Pears & Fisher 2005).

There was some correlational evidence that aspects of EF (e.g. cognitive flexibility) were related to the IF role-play scenarios, which somewhat supports previous research (Bruce et al, 2009; Gorter et al., 2017. EF was not a predictive factor in this research which to some extent contradicts previous studies (Bruce et al., 2009; Gorter et

al., 2017). Interestingly, chapter 6 revealed that children who could identify the advantageous doors when questioned by the researcher during the HDT were better at successfully navigating the computer mediated role-play scenarios in a way that led to safer outcomes, despite the correct door selection not being a predictive factor. This research is important in highlighting that during the primary school years children have the ability to grasp rules and concepts about the social world and that until around 9 or 10 years-old children appear not to have the capacity to apply the knowledge they have in all situations. This means that children can remember what they are not allowed to do or work out right from wrong in a theoretical situation, but they fail to apply these rules in the real world when motivated by other factors or the situation. This is also highlighted through the memory check question in chapter 6 where children were able to remember that they were told not to go with strangers, but still agreed to go with a stranger in that particular scenario. Indeed, children with behavioural issues do not present in the clinic displaying the real-world behaviours that their parents report and can distinguish right from wrong when asked by clinicians (e.g. Minnis et al., 2006).

Study 5 extends current knowledge on the usability of technology to measure social behaviours in children and highlights the importance of the mechanism of computer-mediated role-play for yielding more ecologically valid results and improving end user enjoyment. This is supported by other research which has employed computer mediated role-play such as studies employing Bubble Dialogue (Jones et al., 1998; Rajendran et al., 2005) and more recent research which uses computer role-play to educate children about bullying (Aylett et al 2005).

There is much scope for future research, for example creating a similar IF measure in virtual reality or augmented reality to help with improving feelings of psychological presence (Stater & Wilbur 1997; Tamborini & Skalaki, 2006). Exploring the issue of IF/DSE in looked after children and the predictive factors that contribute to this in more depth. Computer role-play technology would also be suitable as an effective intervention for children and young people to practice their social skills in a safe environment.

The findings will be useful for researchers and practitioners who wish to measure IF/DSE and social vulnerability in middle childhood, and/or employ computer role-play technology as a means to carry out intervention with children and young people who require support with improving their social skills in real world settings.

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APPENDICES

Appendix 1: Specific Symptoms of DSED (DSM-IV, APA 2013)

The stories and scenarios to varying extents capture the themes of the specific symptoms of Disinhibited Social Engagement Disorder (DSM V, APA 2013).

Child actively approaches and interacts with unfamiliar adults and displays a minimum of two of the following:

- A Willingness to go off with an unfamiliar adult with minimal or no hesitation.
- Reduced or absent reticence in approaching and interacting with unfamiliar adults.
- Diminished or absent checking back with adult care giver after venturing away, even in unfamiliar settings.
- Patterns of behaviour that involve culturally inappropriate or overly familiar physical or verbal behaviour with relative strangers.

Appendix 2: Example of the validation ratings of stories/scenarios against the DSM-IV symptoms

1. It's Lisa's first day at the youth club. She arrives early and her mum leaves her with the youth club leader Beth. Beth makes Lisa feel welcome, she offers Lisa a drink and asks her what her favourite games are, and if Lisa has any questions about the youth club. Lisa asks Beth if she has a boyfriend. Beth says yes. Lisa then asks Beth if she can visit her house to meet her Boyfriend. Beth tells Lisa that it would not be a good idea.

Comprehension: Should Lisa have asked Beth if she could visit her house to meet her boyfriend?
Justification: Why does Lisa say that it would not be a good idea?

1. Child actively approaches and interacts with unfamiliar adults.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

2. Willingness to go off with an unfamiliar adult with minimal or no hesitation.

Strongly Agree	Agree	Disagree	Strongly Disagree
☐	x	☐	☐

3. Reduced or absent reticence in approaching and interacting with unfamiliar adults.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

4. Diminished or absent checking back with adult care giver after venturing away, even in unfamiliar settings.

Strongly Agree Agree Disagree Strongly Disagree

☐ ☐ x ☐

5. Patterns of behaviour that involve culturally inappropriate or overly familiar physical or verbal behaviour with relative strangers.

Strongly Agree Agree Disagree Strongly Disagree

x ☐ ☐ ☐

2. It's Shaun's first music lesson with his new music teacher Mrs Booth. Mrs Booth makes Shaun feel welcome, she offers Shaun a drink and asks him what his favourite music is, and if Shaun has any questions about the music lessons. Shaun responds by asking Mrs Booth if she is married. Mrs Booth says yes. Shaun then asks Mrs Booth is he can visit her house to meet her husband. Mrs Booth tells Shaun that it would not be a good idea.

Comprehension: Should Shaun have asked Mrs Booth if he could visit her house to meet her husband?
Justification: Why does Mrs Booth say that it would not be a good idea?

1. Child actively approaches and interacts with unfamiliar adults.

Strongly Agree Agree Disagree Strongly Disagree

x ☐ ☐ ☐

2. Willingness to go off with an unfamiliar adult with minimal or no hesitation.

Strongly Agree Agree Disagree Strongly Disagree

☐	x	☐	☐

3. Reduced or absent reticence in approaching and interacting with unfamiliar adults.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

4. Diminished or absent checking back with adult care giver after venturing away, even in unfamiliar settings.

Strongly Agree Agree Disagree Strongly Disagree

☐	☐	x	☐

5. Patterns of behaviour that involve culturally inappropriate or overly familiar physical or verbal behaviour with relative strangers.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

3. Craig has just joined the boys under 10s football team at his local sports centre. The team coach is called James. He comes into the team changing rooms to talk to the team before they begin football practice. James begins by welcoming the new starters to the team, which includes Craig. Upon hearing his name Craig goes over to James and gives him a hug. On the way home after football practice Craig tells one of his team mates that the football coach James is his new friend. Craig's team mate says that Craig should not have hugged the football coach.

Comprehension: Should Craig have hugged his football coach?
Justification: Why does Craig's team mate say that Craig should not have hugged the football coach?

1. Child actively approaches and interacts with unfamiliar adults.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

2. Willingness to go off with an unfamiliar adult with minimal or no hesitation.

Strongly Agree Agree Disagree Strongly Disagree

☐	☐	x	☐

3. Reduced or absent reticence in approaching and interacting with unfamiliar adults.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

4. Diminished or absent checking back with adult care giver after venturing away, even in unfamiliar settings.

Strongly Agree Agree Disagree Strongly Disagree

☐	☐	x	☐

5. Patterns of behaviour that involve culturally inappropriate or overly familiar physical or verbal behaviour with relative strangers.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

4. Claire is in the sweet shop with her friend Hannah. The shop assistant is very nice to them. She helps them pick out the sweets that they want and also lets them try-out a few sweets for free. Claire gives the shop assistant a hug and tells Hannah that the shop assistant is her new friend. Hannah says that Claire should not have hugged the shop assistant.

Comprehension: Should Claire have hugged the shop assistant?
Justification: Why does Hannah say that Claire should not have hugged the shop assistant?

1. Child actively approaches and interacts with unfamiliar adults.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

2. Willingness to go off with an unfamiliar adult with minimal or no hesitation.

Strongly Agree	Agree	Disagree	Strongly Disagree
☐	☐	x	☐

3. Reduced or absent reticence in approaching and interacting with unfamiliar adults.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

4. Diminished or absent checking back with adult care giver after venturing away, even in unfamiliar settings.

Strongly Agree Agree Disagree Strongly Disagree

☐	☐	x	☐

5. Patterns of behaviour that involve culturally inappropriate or overly familiar physical or verbal behaviour with relative strangers.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

5. Chris and his mum are out walking their dog at night. Chris sees boys playing football in the distance and decides to run towards them without telling his mum. When Chris mum catches up with him she tells him not to do that again.

Comprehension: Should Chris have run ahead at night?
Justification: Why did Chris's mum tell him not to do that again?

1. Child actively approaches and interacts with unfamiliar adults.

Strongly Agree Agree Disagree Strongly Disagree

☐	☐	x	☐

2. Willingness to go off with an unfamiliar adult with minimal or no hesitation.

Strongly Agree Agree Disagree Strongly Disagree

☐	☐	x	☐

3. Reduced or absent reticence in approaching and interacting with unfamiliar adults.

Strongly Agree Agree Disagree Strongly Disagree

☐	☐	x	☐

4. Diminished or absent checking back with adult care giver after venturing away, even in unfamiliar settings.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

5. Patterns of behaviour that involve culturally inappropriate or overly familiar physical or verbal behaviour with relative strangers.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

6. Ben is at a Museum on a School trip. He is walking in line with the rest of his class when he sees a lady besides a painting at the other side of the museum. Ben goes over to introduce himself without asking his teacher Mr Boyce. Mr Boyce walks over and tells Ben to get back in line with the rest of the class.

Comprehension: Should Ben have gone over to the Lady beside the painting?
Justification: Why did Ben's teacher Mr Boyce tell Ben to get back in line with his class?

1. Child actively approaches and interacts with unfamiliar adults.

Strongly Agree Agree Disagree Strongly Disagree

x	☐	☐	☐

2. Willingness to go off with an unfamiliar adult with minimal or no hesitation.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

3. Reduced or absent reticence in approaching and interacting with unfamiliar adults.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

4. Diminished or absent checking back with adult care giver after venturing away, even in unfamiliar settings.

Strongly Agree	Agree	Disagree	Strongly Disagree
☐	x	☐	☐

5. Patterns of behaviour that involve culturally inappropriate or overly familiar physical or verbal behaviour with relative strangers.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

7. Jane is getting the bus home from School with her friends. When Jane gets on the bus, instead of sitting with her friends, she sits beside a lady whom she does not know. Jane asks the lady which is the best stop to get off at for the shopping centre. The lady tells her to get off in 3 stops time. When the bus stops Jane decides to get off with the lady. One of Jane's friends shouts on Jane to come back on the bus.

Comprehension: Should Jane have got off the bus with the lady?
Justification: Why did Jane's friend shout her back?

1. Child actively approaches and interacts with unfamiliar adults.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

2. Willingness to go off with an unfamiliar adult with minimal or no hesitation.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

3. Reduced or absent reticence in approaching and interacting with unfamiliar adults.

Strongly Agree	Agree	Disagree	Strongly Disagree
x	☐	☐	☐

4. Diminished or absent checking back with adult care giver after venturing away, even in unfamiliar settings.

Strongly Agree	Agree	Disagree	Strongly Disagree
☐	☐	x	☐

5. Patterns of behaviour that involve culturally inappropriate or overly familiar physical or verbal behaviour with relative strangers.

Strongly Agree	Agree	Disagree	Strongly Disagree

Appendix 3: IF Story vignettes presented in order of theme matched stories.

It is Susan's birthday soon. She is having a party and wants to invite all of her friends from school. When Susan's mum asks who she would like to invite, Susan says that she would like to invite her teacher, Mrs. Smith. Susan's mum tells her that Mrs. Smith is not really a friend and that she should invite some of the girls and boys from her class instead.

1. Is Mrs. Smith really Susan's friend?

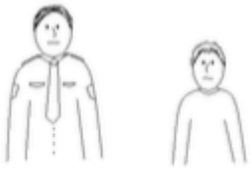
2. Why did Susan's mum say that Mrs. Smith was not really a friend?

It's Halloween soon. Josh decides he wants to go trick or treating with his friends from Scouts. When Joshes dad asks who he would like to invite, Josh says that he would like to invite his Scout leader Mr Brown. Joshes Dad tells him that Mr Brown is not really a friend and that he should invite some of the girls and boys from Scouts instead.

1. Is Mr Smith really Josh's friend?

2. Why does Joshes dad tell Josh that Mr Brown is not really a Friend?

Ben is out shopping with his mum. Ben's mum leaves Ben in the toyshop alone, and tells him that she will come back and get him soon. She tells Ben not to talk to any strangers. While Ben is in the toy shop a man in a security guard uniform comes up to Ben and tells him that his mum had to go to another shop and that Ben should come with him to find her. Ben says "ok", and goes with the man to find him mum.



1. Should Ben have gone with the man?

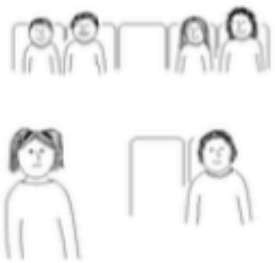
2. Why should he/shouldn't he have gone with the man?

Kim is at the park having a picnic with her family. Kim asks her mum if she can go and play on the swings. Her mum says yes, but not to talk to anyone that she does not know. When Kim is at the swings a man comes over to her, he says to Kim that he has lost his daughter, who is only 4 years old. The man asks Kim if she could help him find her. Without checking with her mum, Kim goes off with the man to look for his daughter.

1. Should Kim have gone with the man to help find his daughter?

2. Why should/shouldn't Kim have gone with the man?

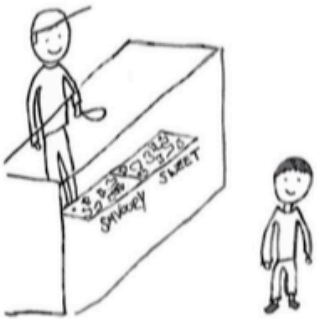
Jane is getting the bus home from School with her friends. When Jane gets on the bus, instead of sitting with her friends, she sits beside a lady whom she does not know. Jane asks the lady which is the best stop to get off at for the shopping centre. The lady tells her to get off in 3 stops time. When the bus stops Jane decides to get off with the lady. One of Jane's friends shouts on Jane to come back on the bus.



1. Should Jane have got off the bus with the lady?

2. Why does Jane's friend shout on Jane to come back?

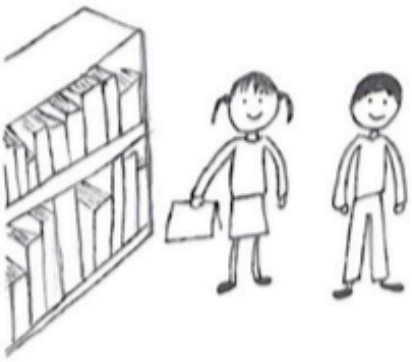
Mark is at the cinema with his family. Mark decides that he wants some popcorn; he goes and queues up at the snacks counter while his family buy the tickets for the film. When Mark reached the counter he can't decide whether he wants sweet or savoury popcorn. He decides to ask the man behind him. The man standing behind him tells him that sweet is nicest. Mark buys the sweet popcorn and decides that he wants to see the film with the man.



1. Should Mark go and see the film with the man?

2. Why does Mark want to go see the film with the man instead of his family?

Anna and her friend Ben are at the library to pick out some story books. When Anna gets to the counter with the book she wishes to borrow, she notices that lady librarian has a moustache and Anna has never seen a lady with a moustache before. Anna decides to ask the lady why she has a moustache, but the lady did not answer her question. On the way home Ben told Anna that she should not ask ladies questions like that.



1. Should Anna have asked the lady why she has a moustache?

2. Why does Ben tell Anna that she should not ask ladies questions like that?

Brian has just started primary 6; his new teacher is Mr McDonald. Brian thinks Mr McDonald is a cool teacher, because he was telling the class about his summer holiday to the USA. Brian puts his hand up and asks Mr McDonald if he got drunk on holiday. Mr McDonald tells Brian that he shouldn't ask questions like that.

1. Should Brian have asked Mr McDonald if he got drunk on holiday?

2. Why does Mr McDonald say that Brian shouldn't ask questions like that?

Zoe is at the pond feeding the ducks with her gran. Zoe sees a man fishing at the other side of the pond, without hesitation she runs round the pond to talk to the man. Zoe's gran shouts for Zoe to come back.

1. Should Zoe be talking to the man?

2. Why did Zoe's gran shout her back?

Max is in a café with his mum and aunt; his mum tells him that because he has been a good boy he can choose an ice-cream cone. On his way to the ice-cream counter Max stops to talk to a man who is sitting having a drink. Max's mum comes over and tells Max not to disturb the man.

1. Should Max be talking to the man?

2. Justification: Why did Max's mum tell him not to disturb the man?

Chris and his mum are out walking their dog at night. Chris sees boys playing football in the distance and decides to run towards them without telling his mum. When Chris mum catches up with him she tells him not to do that again.

1. Should Chris have run ahead at night?

2. Why did Chris's mum tell him not to do that again?

Kelly is walking home at night with her dad; she sees the park in the distance and decides to run ahead to have a go on the swings without telling her dad where she was going. There are lots of teenagers in the park that are much older than Kelly, but she still enters the park. When Kelly's dad caught up with her, he told her not to do that again.

1. Should Kelly have run ahead to the park at night?

2. Why did Kelly's dad tell her not to do that again?

Tom is at the zoo on a school trip, he is walking in line with the rest of his class, and he sees a man beside the penguin enclosure and runs over to introduce himself. Tom's teacher Mrs Clark walks over and tells Tom to get back in line with the rest of the class.

1. Should Tom have gone over to the man beside the penguins?

2. Why did Tom's teacher Mrs Clark tell Tom to get back in line with his class?

Ben is at a Museum on a School trip. He is walking in line with the rest of his class when he sees a lady besides a painting at the other side of the museum. Ben goes over to introduce himself without asking his teacher Mr Boyce. Mr Boyce walks over and tells Ben to get back in line with the rest of the class.

1. Should Ben have gone over to the Lady besides the painting?

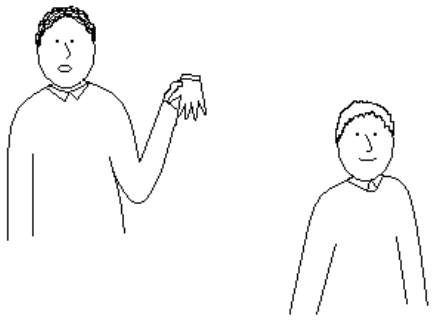
2. Why did Ben's teacher Mr Boyce tell Ben to get back in line with his class?

Jack is playing football with his friend David in the park. They kick the football onto the path by mistake. A man walking his dog passes the ball back to Jack. Jack then says that the man with the dog is now his friend. David says that Jack is wrong — that the man is not his friend.

1. Is the man really Jack's friend?

2. Why does David say that the man is not Jack's friend?

Joe is walking home from school. He drops one of his gloves but does not notice. A man walking past picks up Joe's glove and gives it back to him. When Joe gets home from school he tells his mum that the man that picked up his glove is his new friend.



1. Is the man really Joe's friend?

2. Why does Joe say that the man is his friend?

It's Shaun's first music lesson with his new music teacher Mrs Booth. Mrs Booth makes Shaun feel welcome, she offers Shaun a drink and asks him what his favourite music is, and if Shaun has any questions about the music lessons. Shaun responds by asking Mrs Booth if she is married. Mrs Booth says yes. Shaun then asks Mrs Booth is he can visit her house to meet her husband. Mrs Booth tells Shaun that it would not be a good idea.

1. Should Shaun have asked Mrs Booth if he could visit her house to meet her husband?

2. Why does Mrs Booth say that it would not be a good idea?

It's Lisa's first day at youth club, she arrives early and her mum leaves her with the youth club leader Beth. Beth makes Lisa feel welcome, she offers Lisa a drink and asks her what her favourite games are, and if Lisa has any questions about the youth club. Lisa responds by asking Beth if she has a boyfriend. Beth says yes. Lisa then asks Beth if she can visit her house to meet her Boyfriend. Beth tells Lisa that it would not be a good idea.

1. Should Lisa have asked Beth if she could visit her house to meet her boyfriend?

2. Why does Lisa say that it would not be a good idea?

Craig has just joined the boys under 10s football team at his local sports centre. The team coach is called James. He comes into the team changing rooms to talk to the team before they begin football practice. James begins by welcoming the new starters to the team, which includes Craig. Upon hearing his name Craig goes over to James and gives him a hug. On the way home after football practice Craig tells one of his teammates that the football coach James is his new friend. Craig's teammate says that Craig should not have hugged the football coach.

1. Should Craig have hugged his football coach?

2. Why does Craig's teammate say that Craig should not have hugged the football coach?

Claire is in the sweet shop with her friend Hannah. The shop assistant is very nice to them. She helps them pick out the sweets that they want and also lets them try-out a few sweets for free. Claire gives the shop assistant a hug, and tells Hannah that the shop assistant is her new friend. On the way home Hannah says that Claire should not have hugged the shop assistant.

1. Should Claire have hugged the shop assistant?

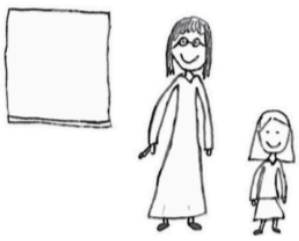
2. Why does Hannah say that Claire should not have hugged the shop assistant?

When Kevin returned from school his mum was in the living room having tea with a lady that Kevin had not met before. Kevin's mum tells him that this is Mary who is an old friend from School. When Mary gets up to leave Kevin decides he wants to go home with her. Kevin's mum tells him that he is not allowed to go with Mary.

1. Do you think that it is okay for Kevin to go home with Mary?

2. Why did Kevin's mum say that he was not allowed to go home with Mary?

Polly's favourite teacher at school is Miss Taylor, because she is always very kind to the class. After school one day Polly tells her teacher that she would like to live with her. Miss Taylor says that Polly cannot live with her.



1. Do you think it would be okay for Polly to live with Miss Taylor?

2. Why does Miss Taylor tell Polly that she cannot live with her?

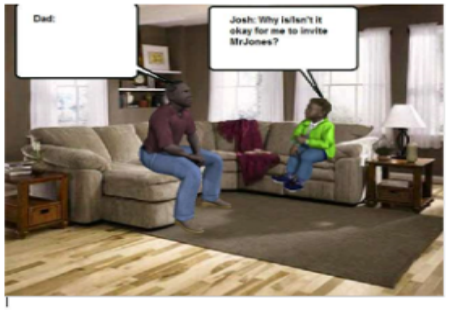
Appendix 4: IF Computer mediated role-play scenarios presented in order of theme matched scenarios.

It's Susan's birthday soon and she is having a party with the girls and boys from school. Susan's mum asks who she would like to invite to the party.

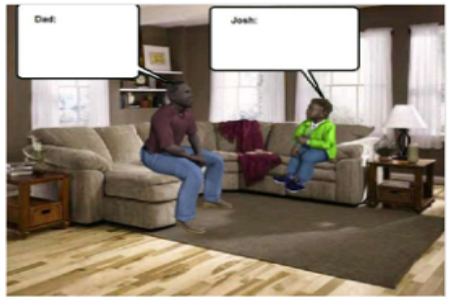
Further Discussion if required?

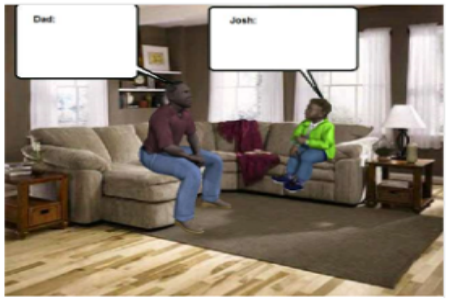
kar2ouche

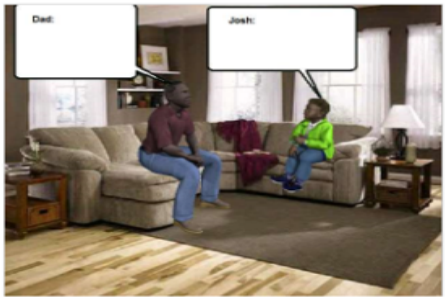
Its Halloween soon. Josh has decided he wants to go trick or treating with his friends from scouts. Joshes dad asks who he would like to invite, so that it can be organised.



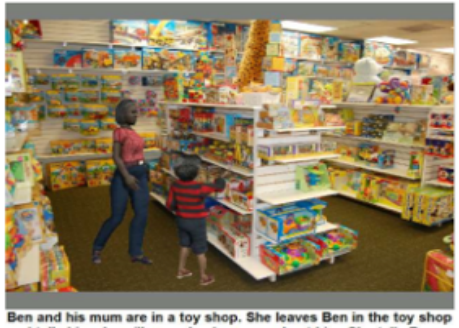
Further discussion if required







kar2ouche



Ben and his mum are in a toy shop. She leaves Ben in the toy shop and tells him she will come back soon and get him. She tells Ben not to talk to any strangers.

While Ben is in the toy shop, a man in a security guard uniform comes up to Ben.

Ben's Mum comes back into the toy shop to collect Ben. She listens to Ben talking to the man in the security uniform.

Further discussion if required

kar2ouche

Kim is at the park having a picnic with her family.

Kim asks her mum if she can go and play on the swings. Her mum says yes, but not to talk to any strangers.

When kim is at the swings a man comes over to her.

Kims Dad spots her talking to the the man and goes over to them.

kar2ouche

Jane is getting the bus home from school with her friend Sarah.

When Jane gets on the bus, instead of sitting with her friend Sarah, she sits beside a lady whom she does not know.

Jane asks the lady where to get off for the shopping centre.

but at the next stop, Jane decides to get off the bus with the lady.

kar2ouche

Mark is at the cinema with his family. Mark decides that he wants some popcorn; he goes and ques up at the snacks counter while his family buy the tickets for the film.

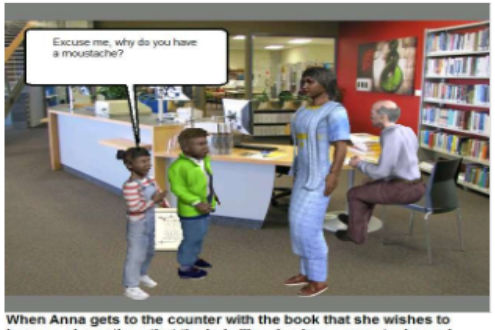
When Mark reaches the counter he can't decide whether he wants sweet or savory popcorn. He decides to ask the man behind him.

Mark buys the sweet popcorn and decides that he wants to go and see the film with the man.

Marks dad walks over to Mark

kar2ouche

Anna and her friend Ben are at the library to pick out some story books.



When Anna gets to the counter with the book that she wishes to borrow, she notices that the lady librarian has a moustache and Anna has never seen a lady with a moustache before. Anna decides to ask the lady why she has a moustache, but the lady did not

On the way out of the library Anna and Ben have a chat.

Further discussion if required

kan2ouche

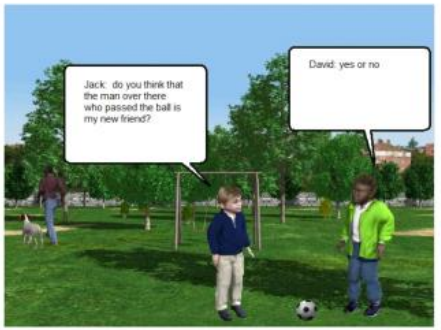
Brian has just started primary 6; his new teacher is Mr MacDonald. Brian thinks Mr MacDonald is a cool teacher, because he was telling the class about his summer holiday to the USA.

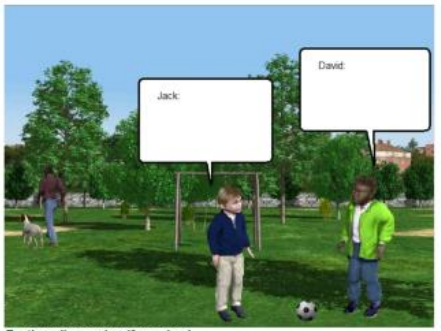
Brian Puts his hand up and asks Mr MacDonald if he got drunk on holiday.

Further dialouge to confirm understanding if needed

Jack is playing football with his friend David in the Park.

They accidently kick the ball too far away. A man walking his dog passes the ball back to Jack.





Further discussion if required

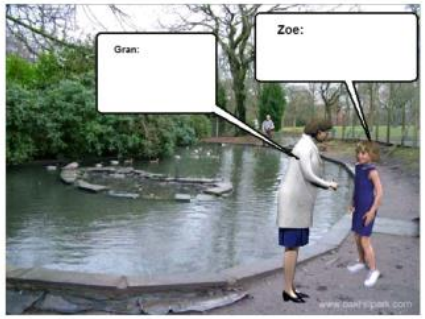
Joe is walking home from school. He drops one of his gloves but does not notice. A man walking past pick's up Joes glove and gives it back to him.

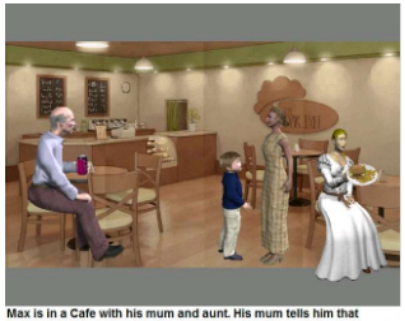
When Joe gets home from school he tells his mum that the man who picked up this glove is his new friend.

Further Discussion if required

Zoe is at the pond feeding the ducks with her gran. Zoe sees a man fishing at the other side of the pond.

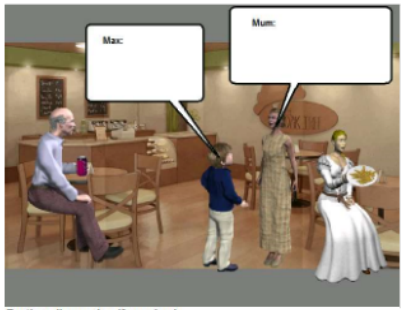
Without hesitation she runs round the pond to talk to the man. Zoe's gran shouts on her to come back.



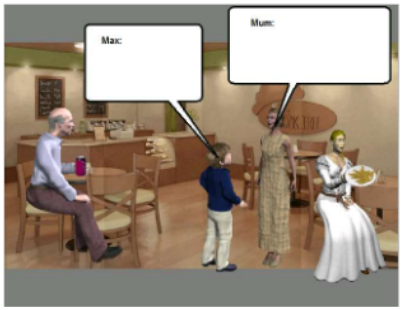


Max is in a Cafe with his mum and aunt. His mum tells him that because he has been a good boy he can choose an ice-cream cone.

On his way to the ice-cream counter Max stops to talk to a man who is sitting drinking coffee.



Further discussion if required



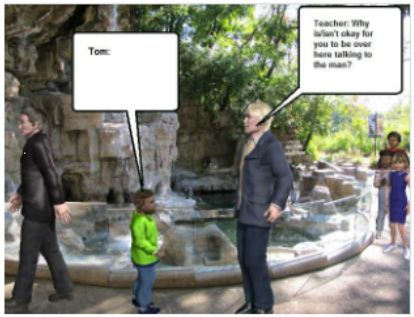
kar2ouche

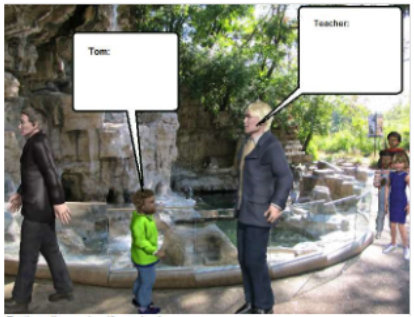
Cafe

Tom is at the zoo on a school trip, he is walking in line with the rest of his class.

When Tom sees a man beside the penguin enclosure, he goes over to introduce himself, without asking his teacher.

Toms teacher comes over.



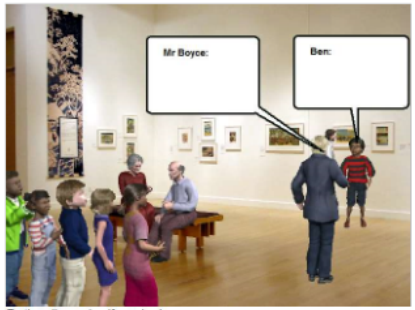


Further discussion if required

Ben is at the museum on a School trip. He is walking in line with the rest of his class, when he sees a lady beside a painting at the other side of the museum.

Ben goes over to introduce himself to the lady, without asking his teacher Mr Boyce.

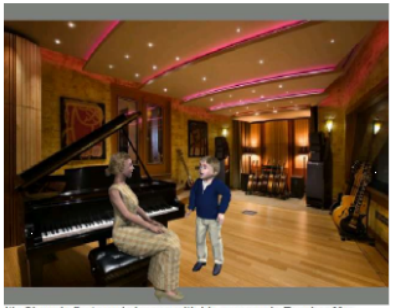
Mr Boyce walks over to Ben



Further discussion if required

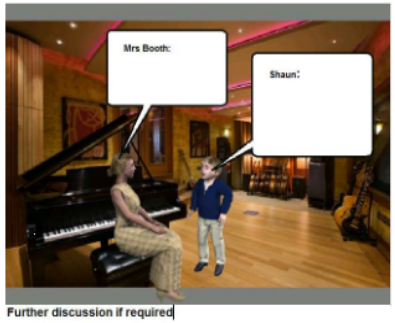
kar2ouche

Museum



It's Shaun's first music lesson with his new music Teacher Mrs Booth. Mrs Booth makes Shaun feel welcome, she offers Shaun a drink, asks him what his favourite misic is, and if Shaun has any questions about the music lessons.

Shaun Responds by asking Mrs Booth if she is married.



Further discussion if required

kar2ouche

It's Lisa's first day at youth club, she arrives early and her mum leaves her with the youth club leader Beth.

Beth makes Lisa feel welcome, she offers lisa a drink and asks her what her favourite games are, and if Lisa has any questions about the youth club. Lisa responds by asking Beth if she has a boyfriend. Beth says yes.

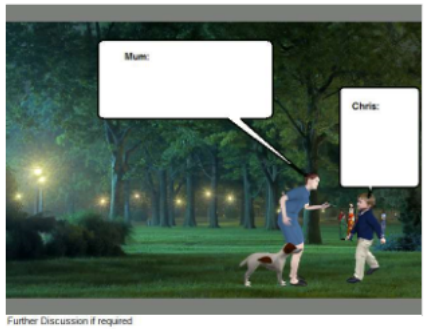
Further discussion if required

kar2ouche

Chris and his mum are out walking their dog at night. Chris sees boys playing football in the distance.

Chris decides to run towards them without telling his mum.

Chris' mum catches up with him.



Further Discussion if required

kar2ouche

Walking the dog

Kelly is walking home at night with her dad.

Kelly sees the swing park in the distance and decides to run to have a go on the swings, without telling her dad where she is going.

There are lots of teenagers in the park that are much oldrer than Kelly, but she still enters the park.

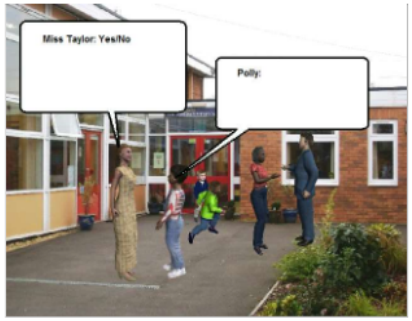
When Kellys dad catches up with her, he says:

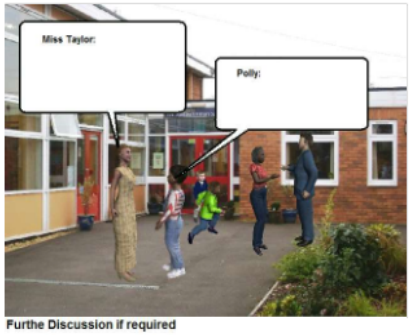
Further Discussion if required

kar2ouche

Polly's favourite teacher at school is miss taylor, because she is always very kind to the class.

After school one day polly decides that she would like to go home with her teacher Miss Taylor.



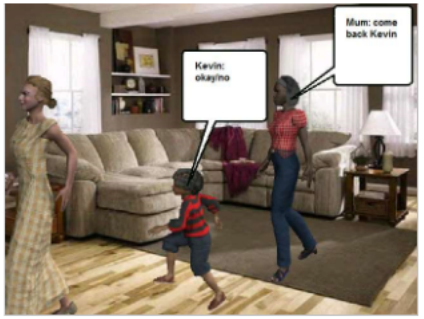


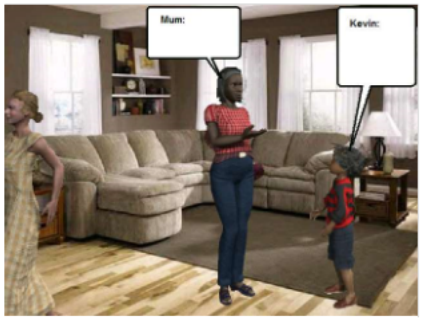
Furthe Discussion if required

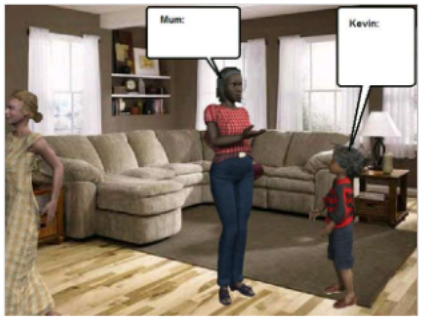
kar2ouche

When Kevin returned home from school, his mum was in the living room chatting with a lady he had not met before. Kevins mum tells him that this is Mary, who is an old friend from school.

When Mary gets up to leave, Kevin decides he wants to go with her.







kar2ouche

Craig has just joined the boys under 10s football team at his local sports center. The team coach is called James. He comes into the team changing rooms to talk to the team before they begin football practice. James begins by welcoming the new starters to the team, which includes Craig.

Upon hearing his name Craig goes over to James and gives him a hug. and tells one of his teammates that the football coach is his new friend.

After football practice Craig walks home with his teammate John.

kar2ouche

Claire is in the sweetshop with her friend Hannah. The Shop assistant is very nice to them. She helps them pick out the sweets that they want and also lets them try out a few sweets for free.

Claire gives the shop assistant a hug, and tells Hannah that the shop assistant is her new friend.

kar2ouche

sweetshop

Mark is at the cinema with his family. Mark decides that he wants some popcorn; he goes and ques up at the snacks counter while his family buy the tickets for the film.

When Mark reaches the counter he can't decide whether he wants sweet or savory popcorn. He decides to ask the man behind him.

Mark buys the sweet popcorn and decides that he wants to go and see the film with the man.

Marks dad walks over to Mark

kar2ouche

cinema 2

Appendix 5: Computer mediated role-play scenarios with extra response added.

Jane is getting the bus home from school with her friend Sarah.

When Jane gets on the bus, instead of sitting with her friend Sarah, she sits beside a lady whom she does not know.

Jane asks the lady where to get off for the shopping centre.

but at the next stop, Jane decides to get off the bus with the lady.

kar2ouche

bus2

Kelly is walking home at night with her dad.

Kelly sees the swing park in the distance and decides to run to have a go on the swings, without telling her dad where she is going.

There are lots of teenagers in the park that are much oldrer than Kelly, but she still enters the park.

When Kellys dad catches up with her, he says:

kar2ouche

parkatnight2

Chris and his mum are out walking their dog at night. Chris sees boys playing football in the distance.

Chris decides to run towards them without telling his mum.

Chris' mum catches up with him.

kar2ouche

walking dog 2

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Investigating social vulnerability in children using computer mediated role-play

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ABSTRACT

Here, we report a study using computer role-play to investigate Disinhibited Social Engagement in 54 typically developing children aged 6, 8 and 10 years. Children completed 22 (theme-matched) vignettes and computerised scenarios that captured the themes of the specific symptoms of Disinhibited Social Engagement Disorder (DSM V, APA, 2013). Our newly created 22 'Paper pencil' vignettes and computer role-play scenarios were used in conjunction with the Strange Stories (O'Hare, Bremner, Nash, Happé & Pettigrew, 2009) and Parents and Teachers completed versions of the Relationship Problems Questionnaire (RPQ: Minnis et al., 2007). Our findings revealed the developmental (age) differences of social vulnerability/indiscriminate friendliness and potential advantages of computermediated role-play in comparison to "paper pencil" tasks. We argue that using a method of children role playing characters gives a better insight into children's true vulnerabilities. We discuss our findings in relation to using this methodology for clinicians and researchers to improve social skills in the most socially vulnerable children.

1. Introduction

Child friendly software applications are now commonplace. As well as providing learning and entertainment, they have opened an exciting avenue for research to help children with social and cognitive difficulties via intervention and clinical assessment. Research in this field tends to integrate computer technology with real world-based activities, as a means to carry out research with children in a safe, controlled and ethical environment.

The most popular areas of research in this area tend to be interventions to improve social skills, cognitive skills, and learning (Beals, 2016; Vannini et al., 2011; Wass & Porayska-Pomsta, 2013). By contrast, our research reported in this paper uses this technology for psychological and behavioural assessment in children. Clinicians who assess children who are diagnosed with developmental disorders and/or whom display problem behaviours, report that children often do not present their problem behaviours in the clinic. Indeed, these children can give socially appropriate answers when questioned, but do not conduct themselves in a "socially desirable" manner in the real world (Minnis et al., 2010). Certainly, some children can be very socially aware, particularly if they have experienced a difficult upbringing; while others may not have the verbal sophistication required to describe their experiences in an interview, questionnaire or person-centered role-play task (Minnis et al., 2010). Therefore, accurately assessing social behaviours in children can be difficult. So, there is a need for measurement tools that are more representative of real life environments that can be reliably and consistently administered by researchers and clinicians alike, in a manner that children can engage

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with. At the same time as this need for appropriate assessment, there is a burgeoning interest in serious gaming. Here, video game elements are used in nongaming systems to improve user experience and engagement, at face value these can be perceived to be games for entertainment, but in the development of serious games the designers will have disguised an education or training purpose (Stokes, 2005; Vannini et al., 2011).

Although the measures used in this reported study can be used as a general measure of social vulnerability in middle childhood, they were initially created with a more extreme clinical population of vulnerable children in mind (in order to capture the nature of vulnerable behaviours more accurately), specifically, Disinhibited Social Engagement (DSE or indiscriminate friendliness IF) is a highly prevalent trauma and stressor related disorder. Described in the DSM-V, (APA, 2013) as a pattern of behaviour in which a child actively approached and interacts with unfamiliar adults, DSE is a tendency to be unduly affectionate and disinhibited towards others. This can result from or leave children vulnerable to child abduction and/or abuse, which are among the most common offenses committed against children. Currently, our knowledge on children's' disinhibited social behaviour is largely derived from observational and qualitative research (Bennett, Espie, Duncan, & Minnis, 2009; Bruce, Tarullo, & Gunnar, 2009; Lawler, Hostinar, Mliner, & Gunnar, 2014). This research generally focuses on DSE in infants and adolescents because measuring this level of social behaviour accurately in middle childhood has proved challenging for both clinicians and researchers (Minnis, Read, Connolly, Burston, Schumm, Putter-Lareman & Green, 2010).

Until 2013, DSE was classified as a sub-type of reactivate attachment disorder (RAD). Therefore, questionnaire measures of DSE/IF tend to be a sub-scale in measures of RAD. For example, Millward et al. (2006), Minnis, Rabe-Hesketh, and Wolkind (2002), & Minnis et al. (2007) assessed RDA & DSE behaviours using the relationships problems questionnaire, which are parent and teacher checklists for RDA that includes a sub-scale measure of DSE/IF. This measure is widely used to assess children's DSE/IF behaviors in research and clinical settings. However, this questionnaire does not give the clinician or the researcher the ability to witness the child's behaviors. So, there is much need for measures that focuses on the 'real world' DSE/IF behaviors in middle childhood. We employed the RPQ as an additional measure of DSE/IF in this research.

As well as measuring DSE/IF, we argue that for a typical population of children, our computer role-play task is a valid measure of social vulnerability. We propose that computer role-play technologies, as opposed to traditional 'paper and pencil' measures, offer a valuable method for measuring social behaviours in clinical settings and controlled research environments that can provide a 'more real to life' or fidelity of assessment of children's social behaviour – because of the interactive participation that the children have to take. Here, we highlight the potential benefits of computer role-play technologies as psychological measurement tools for assessing children's social behaviour in a more ecologically valid way.

1.1. Measuring children's social understanding

Since Wimmer and Perner's (1983) seminal work, measuring children's social understanding has come from a theory of mind tradition (ToM: An understanding that another's mental state/intentions may be different from your own): From using dolls (e.g. Baron-Cohen, Leslie, & Frith, 1985), to advanced theory of mind measuring story vignettes (e.g. Happé, 1994; see Rajendran & Mitchell, 2007, for a historical review). Happé's 'Strange Stories' are simplified narratives of everyday scenarios followed by questions that assess the participants understanding of nonliteral language short stories (included measures of sarcasm, figures of Speech, white lies, etc.). Versions of these stories have been shown to even discriminate developmental stages (e.g. O'Hare, Bremner, Nash, Happé & Pettigrew, 2009) and between those who do and do not have ASD (Happé, 1994) and disinhibited attachment disorder (Kay & Green, 2016). Even those who passed 2nd order ToM tasks gave incorrect responses to some of the strange stories (Happé, 1994; Jolliffe & Baron-Cohen, 1999).

Despite the popularity of story vignettes, it is argued that most of the experimental paradigms designed to assess ToM abilities involve fairly well developed expressive and receptive language skills, which can cause issues, since many groups of children have poor verbal abilities (Colle, Baron-Cohen, & Hill, 2007). Thus, failure on such tasks may in fact reflect participants' inability to comprehend task instructions, nearly as much as deficits in mental-state understanding (Astington, 2001; Frye, Zelazo, & Palfai, 1995). As such other novel approaches have been suggested, for example; Sivaratnam, Cornish, Gray, Howlin, and Rinehart (2012) successfully validated a colorful comic strip ToM measurement tool that better relies on non-verbal abilities to facilitate children who suffer from language related impairments. The success of this type of task relies on clear visuals such as the characters changing emotions and changing scenes presented in each scenario to help the children follow the story with ease in a non-verbal way.

However, Rajendran and collengues (Rajendran & Mitchell, 2000; Rajendran, Mitchell & Rickards, 2005) argued that such tasks (Verbal or nonverbal) measure children's *reflective* rather than *working* understanding and that computer-role play offers a truer indication of children's understanding. Computer-role play offers the chance of putting 'oneself in another's shoes' and potentially having to simulate (Harris, Kavanaugh, Wellman, & Hickling, 1993; Jones, Price, & Selby, 1998), what a character might do in a hypothetical situation. This is in contrast with the story vignette paradigm in which a child might feel under pressure to give the correct or most appropriate answer (Siegal, 2004) or have to work the correct answer in a more abstract or 'theory theory' type way (e.g. Chapman, 1988).

Another advantage of using computer-role play technology is that it is immersive – that is it can give players a sense of "psychological presence" of being there (Tamborini & Skalski, 2006) and identity (Gee, 2014). Presence is important because the greater the degree of presence, the more chance that participants will behave in a virtual environment, in a manner which is comparable to their behaviour in the "real world". Arguably, presence brings into play "natural" responses to a situation (e.g. Slater & Wilbur, 1997).

1.2. Technologies in research with children

Recent research from a range of disciplines including psychology, psychiatry, education and computer science (e.g. Fletcher-Watson et al., 2014; Hall, Woods, & Hall, 2009; Minnis et al., 2010; Porayska-Pomsta et al., 2012; Rajendran et al., 2005) have highlighted the potential benefits of utilising technologies in the measurement and intervention of social behaviour in various groups of children, particularly those with Autism Spectrum Disorder (ASD) who seem to display an affinity with these technologies (See Rajendran, 2013; Wass & Porayska-Pomsta, 2013 for reviews).

Despite research that focused on the negative impacts of playing video games (Anderson & Bushman, 2001), serious games can contribute to knowledge and skill acquisition (Boyle et al., 2016). Furthermore, both typically and atypically developing children play video games for pleasure. They will immerse themselves in these games and increasingly, interact with peers for hours through online gaming, despite perhaps having cognitive or social issues which cause them difficulties with other everyday "real world" tasks (Durkin, 2010).

At present the vast majority of the research on technology-based measurement and intervention tools are largely focused on facilitating children and young people with ASD, (e.g. Fletcher-Watson, Pain, Hammond Humphry, McConachie, 2016; Parsons, 2016; Wass & Porayska-Pomsta, 2013). Although there are many similar research endeavors aimed at supporting children with other developmental and psychological disorders e.g. Attention Deficit Hyperactivity Disorder (ADHD) and Specific Language Impairment (LI: Fletcher-Watson & Durkin, 2014).

Some examples of research with a focus on children and young people with ASD includes, Beaumont and Sofronoff (2008) 'Secret Agent Society' which aimed to improve emotional and behavioural skills in individuals with High-Functioning Autism. Beaumont and Sofronoff carried out a randomised control trial which included a range of individual computer-based training in social skills, with some group work and some parental input. The researchers found that post intervention resulted in improvements in social skills in the playground and classroom. However, because these skills were not directly observed, it has been argued that future research should aim to directly measure social skills in children and, so, focus on the *process* as well as the *outcome* (Golan, Sinai-Gavrilov, & Baron-Cohen, 2015; Whalen et al., 2010). Social stories software, such as Story Maker ™ (Kokina & Kern, 2010), offer a way to directly measure the process by shifting away from "paper pencil" outcome measures to computer role play. These digital measures also mean that hundreds of social stories can now be stored on a single device. Despite this methodological advantage, convenience and portability, there have been – to date – no direct comparisons between performance on social story computer games and traditional "paper pencil" formats.

The utility of storytelling apps and computer games seems especially beneficially for understanding children's social development. For example, Happé and Frith (2014) highlighted there are a number of developmental disorders which are primarily characterised by social cognitive atypicality other than Autism Spectrum disorders e.g. Williams Syndrome, Downs Syndrome, ADHD and Specific Language Impairment (SLI). So, along with attachment-related disorders such as Disinhibited Social Engagement Disorder, this gives measures of social cognition wide scope for validation.

Extant research suggests that individuals treat computerised objects and space just as they do when interacting in "real-world" social situations and relationships (e.g. Reeves & Nass, 1996). So, this social interaction with computers facilitates a safer environment in which to assess children and young people's behaviours in social relationships and environments – but without losing real-world engagement. Using computer-mediated role-play, therefore, provides a more 'person-centered' approach to understanding children's social behaviour rather than from a third person perspective. Indeed, there is increasing appreciation of the potential of computer-assisted role-play environments as effective, appropriate, engaging, tools (Imholz, 2008). These platforms provide virtual learning environments (VLEs) populated by synthetic/digital characters engaged in role-play scenarios that can offer users safe and compelling access to real-world social and emotional experiences (Dautenhahn, Bond, Canamero, & Edmonds, 2002).

Recent interdisciplinary work has produced prototype tasks for measuring children's social understanding, e.g. using a virtual role-play program called 'FearNot!' (E.g. Hall et al., 2009). Here, ToM methods were used to gain insights into children's (N = 345) abilities to correctly attribute beliefs, desires, goals and precepts to others, through a virtual role-play task about bullying in which the participants were 'synthetic characters' (i.e. computer generated), rather than actual children undergoing a real bullying experience. The children who took part role-played a third character that played a "friend" who gave the victim advice after they had viewed the bullying scenario. This advice was then used to measure the child participant's social understanding and Theory of Mind. Thus, it is clear to see that computer role-play is a fruitful tool for assessing children's social understanding.

As well as computer role-play being a useful tool for assessing children's social understanding, it can be utilised to measure other social behaviour in children, for example attachment issues. In infants, attachment issues are most commonly measured using the 'Strange Situations' procedure (SSP: See Ainsworth, 1979). However, the SSP is not appropriate for measuring attachment difficulties in older children, which has proved to be notoriously difficult (e.g. Minnis et al., 2010). One task that does reliably measure attachment issues in middle childhood, however, is the 'Manchester Child Attachment Story Task' (MCAST: Green, Stanley, Smith, & Goldwyn, 2000). This is a representational procedure for assessing attachment patterns of young school aged children. The task is based around a doll's house and after hearing a story from the task administrator the child participant then takes on the role of a doll to complete the scenario (i.e. the child represents themselves through the doll).

Minnis et al. (2010) developed a computerised version of the MCAST (the CMCAST), that can be used on any standard computer. Story stems are represented on the computer by the movement of two-dimensional 'dolls' narrated by a generic voice. Children then take control of the task and complete each story by speaking into the computer; the audio-visual data produced by the child can be downloaded for later rating. The findings revealed that the CMCAST had similar reliability and validity as the MCAST and yielded further benefits. For example, it is easier to administer for large sample epidemiological studies, reduced reliance on trained

Table 1
Participant characteristics.

Age Groups	N	Gender	14 -TRPQ Mean (SD)	10-PRPQ Mean (SD)
6	16	M8, F8	2.96 (2.10)	.94 (.37)
8	17	M8, F9	1.59 (1.80)	0.65 (.93)
10	20	M9, F11	0.90 (1.29)	0.20 (.52)

researchers in task procedures, less exhaustive involvement of the researcher, has the potential to yield truer more ecologically valid responses, and is slightly cheaper to administer than the MCAST.

1.3. The present study

Here, we investigated a) age-related developmental differences in DSE in middle childhood and b) potential advantages of computer mediated role-play tasks as measures of DSE over a "paper pencil" tasks. We also investigated the relationship between DSE, Theory of Mind (ToM), and parent and teacher ratings of the child's quality of relationship (RPQ). Children were, therefore, asked to comprehend vignettes and role-play various characters in a variety of scenarios to investigate their DSE.

2. Method

2.1. Participants & design

A total of 54 children were recruited to this study: 3 groups of typically developing children aged 6, 8, & 10 (see Table 1). However, one participant from the 10-year-old group was removed due to her score on the computer mediated-role play task being much higher than the mean score for this age group. We used a 3 × 2 factorial design: with a between subject's factor of age and a within subject's factor of presentation ('paper and pencil vignette' vs. 'computer role-play' version of the DSE task).

2.2. Materials & procedure

The computer-mediated role-play scenarios and story vignettes were independently validated by the 3rd author, who is an expert in the field of child reactive attachment disorder and Disinhibited Social Engagement Disorder using a 5-point rating system (Strongly agree to Strongly Disagree) on each of the disinhibited social engagement disorder symptoms (DSM-V 2013). It was agreed that every story tapped into one or more of the specific symptoms of DSE. Both paper and pencil and computer versions of the DSE tasks are matched on themes and scoring to make them comparable. These tasks were counterbalanced across participants. The order of scenarios and vignettes were pseudo-randomised across participants.

The 14 item Teacher Relationship Problems Questionnaire (TRPQ) and 10- item Parent Relationships Problems Questionnaire (PRPQ: e.g. Minnis et al., 2007; Millward et al., 2006) and the already well-established Strange Stories ToM vignettes (O'Hare et al., 2009) were employed. The 10-item PRPQ was sent to parents to be completed along with the consent form, these were then returned to the child's school. The child participants took part in 3 × tasks: 1 = Paper and pencil ToM vignettes (Strange Stories: O'Hare et al., 2009), 2 = Paper and pencil DSE vignettes, (appendix A: Please contact first author for complete materials) 3 = Computer role-play measure of DSE in a children's computer story boarding called Kar2ouche (see appendix B: Please contact first author for complete materials). The class teachers completed the 14 –item Teacher RPQ on each child who took part in the study. The RPQ's are a measure of children's social behaviour's that relate to the themes of Disinhibited Social Engagement Disorder and have been validated on both atypical and typical populations of children (e.g. Minnis et al., 2007).

The children worked along with the researcher individually in a quiet room at their school. Testing time was approximately 1 h per child and short breaks were granted at the child's leisure.

2.3. Scoring procedures

2.3.1. Strange stories

12 strange stories accompanied by pictures were read out. Two questions per story were asked, the first requiring a 'yes or no' comprehension answer and the second requiring an open-ended justification answer. The procedure and scoring are in accordance with O'Hare et al., 2009.

2.3.2. Paper and pencil vignettes

11 different vignettes were used (appendix A). Comprehension questions were rated as correct (1) or incorrect (0). Responses to the justification questions require more subjective judgements on the part of the scorer. One point was awarded for each response that indicated that the child was engaged in behaviours which could lead them to be socially vulnerable, these behaviours were judged on the criteria from the DSM-V for each of the themes being investigated. A score of zero was give when the child's response

indicated correct justification of the question. Thus, the scoring of each vignette was between 0 and 2. Two raters coded the responses; the first rater was the primary researcher during the testing phase and coded all the data. The second rater was naive to the aims of the study and blind to participants' group membership; they coded 20% of the data. Any inconsistencies or confusion over answers/scores were resolved through discussion between the raters after the initial blind rating took place; inter-rater reliability ($r = .82$).

2.3.3. *Computer mediated role-play scenarios*

11 different computer mediated role-play scenarios were used (appendix B). Like the Story vignettes, comprehension questions where the child responded with a yes or no were rated as correct (1) or incorrect (0). Responses to the justification questions require more subjective judgements on the part of the scorer. One point was awarded for each response that indicated that the child was engaged in behaviours which could lead them to be vulnerable; these behaviours were judged on the criteria from the DSM-V for each of the themes being investigated. A score of zero was give when the child's response indicated correct justification/awareness of the safest actions to be taken. So, the scoring of each vignette was between 0 and 2. Two raters coded the responses; the first rater was the primary researcher during the testing phase and coded all the data. The second rater was naive to the aims of the study and blind to participants' group membership; they coded 20% of the data. Any inconsistencies or confusion over answers/scores were resolved through discussion between the raters after the initial blind rating took place; inter-rater reliability: ($r = .99$).

3. Statistical analysis

One repeated measures 3 × 2 factorial ANOVA: with a between subject's factor of age and a within subject's factor of presentation ('paper and pencil vignette' vs. 'computer role-play' version of the DSE task). Additionally, the 14 TRPQ and 10- item PRPQ: were correlated using Pearson's correlations with the Strange Stories (O'Hare et al., 2009). All analysis was carried out using IBM SPSS statistics 22.

4. Results

There was a significant main effect of task presentation (computer mediated role-play, paper and pencil) [$F(1, 47) = 34.66$ $p < 0.001$ Cohen's $f = 0.86$] *Post hoc* tests revealed that 6-year-olds displayed more DSE than 8-year-old s ($p < 0.001$) and 10 year-olds ($p < 0.001$). There was no significant difference between 10 & 8-year olds, $p = .287$. There was a significant interaction between task presentation (Computer Mediated Role-Play, Paper and Pencil) and the age group of participants [$F(2, 47) = 3.27$ $p = .047$ Cohen's $f = 0.37$]. *Simple effects analysis* revealed that 6 years-olds ($p < 0.001$) and 8-year-olds($p = .002$) displayed significantly more DSE in the computer mediated role-play task, than in the paper and pencil vignettes, whereas 10-year-olds DSE did not significantly differ between task presentation ($p = .081$). See Fig. 1.

Theory of Mind was negatively correlated to both DSE tasks with a Pearson correlation coefficient of $r = -.439$ and a significance value of < 0.001 for the paper pencil task and Pearson correlation coefficient of $r = -.379$ and $p = 0.003$ for the computer mediated role-play task.

No correlations were found for the RPQ'S and DSE in either task presentation (paper and pencil, computer mediated role-play). This is probably because the RPQ is a clinical measure and typically developing children were recruited in this study.

5. Discussion

First, our results show DSE behaviours seems to be developmental, i.e. 10 and 8-year-old showing fewer disinhibited behaviours than 6-year olds. Second this age differentiation was greater in the computer mediated role-play version of the task. So, these findings support our hypothesis that children will exhibit more DSE behaviours in the computer role-play than the paper and pencil version of the task. Third, our prediction that there would be a negative relationship between DSE and ToM was also supported which is

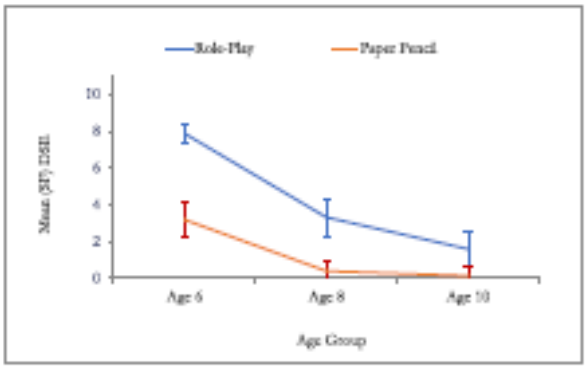

Fig. 1. Mean (SE) DSE by task presentation (Role-Play & Paper Pencil) and age group.

particularly important to validating the measure.

This study was also the first to successfully quantify DSE and social vulnerability in middle childhood and is, also, the first to investigate the development of DSE and social vulnerability in the typical population of children. Further, we show the value of computer mediated role-play, which extends serious gaming's current sphere of research activity into the field of children's psychosocial measurement.

Our findings support previous research that suggests using computer mediated role-play measures children's working understanding in comparison to vignettes that rely on a more reflective understanding (Rajendran & Mitchell, 2000; Rajendran et al., 2005). Arguably the younger children performed in a way that is closer to their real-life behaviours in the role-play task because this allowed the child to simulate or "walk in the shoes" of the character and make real decisions in a simulation type way (e.g. Harris et al., 1993). Rather than deciding on what the characters might do in a hypothetical situation that is created using social vignettes where a child might feel under pressure to give the correct or most appropriate answer (Siegal, 2004), or have to work the correct answer out in more abstract or 'theory theory' type way (e.g. Chapman, 1988). This method seems to be especially valuable for children in the middle childhood range of around age 5–9 years old, whereas there was no significant difference in the scores of the "paperpencil" and computer mediated role-play task version for the older children. This may because by the end of middle childhood/primary school years, typically developing children have largely mastered basic awareness of social safety.

Thus, from a theoretical perspective, the findings support a simulation theory account of the development of ToM in middle childhood (Harris et al., 1993). This is important because it suggests that children's "real-world" behaviour is more likely to be measured accurately from a first person (e.g. role-play), rather than a third person (Paper and pencil) perspective. This finding also arguably supports the concept of presence (e.g. Slater & Wilbur, 1997), in which responses in the computer mediated role-play version are more like the responses that participants might give in real life.

However, an alternate explanation may be that higher levels of disinhibited behaviour in a computer mediated role-play task were due to the perceived safety of the environment. We argue though that this is unlikely because we recruited only typically developing children and found that most participants in the youngest age group (6-year-olds) achieved approximately only a quarter of the potential total disinhibited score available. This means that disinhibited and vulnerable behaviours are relatively low (as to be expected in this population), so there is plenty of "room" in the assessment to measure atypical behaviour. In order to fully validate this measure, therefore, it is important that future studies look at the differentiation of typical and atypical DSE and social vulnerability in middle childhood.

Indeed, such future research would add to the validation of this psychological measurement and has the potential to be of use in research related to attachment and disinhibited social engagement disorder, which up until now has been largely observational and qualitative in nature (e.g. Bennett et al., 2009). Children with attachment related disorders tend to display signs of social vulnerability, which in part along with cognitive and environmental factors is thought to be related to having a poor theory of mind (Kay & Green, 2016; Pears & Fisher, 2005). Our findings demonstrated that poor theory of mind was related to higher levels of DSE or social vulnerability and (vice versa; good theory of mind is related to better social safety understanding or DSE).

In practical terms, this means that some children can be very socially vulnerable when interacting with unfamiliar adults, as they cannot understand that the thoughts and intentions of others may be diffrent from their own thoughts and intentions. Therefore, creating a safe virtual environment that maps on to real-life settings to asses these social vulnerabilities is essential for clinicians and researchers in this field. Meaning the findings in the present research have implications for how technological advancement can be useful in both assessment and intervention in research, clinical practice and education.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.compedu.2018.06.027.

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